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Technology Review

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MAY/JUNE 1983

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How Mercedes-Benz harnesses the wind.

This 300SD measures almost 17 ft. long, weighs 3,780 lbs., affords 108.8 cu. ft. of interior volume. But the wedge-shaped body 1 is so skillfully contoured, that its 0.36 Cd is bettered by no other 4-door sedan sold in the U.S. today.

Brake-generated heat buildup is dissipated into airstream 2 via heavily slotted alloy wheels.

Inlet at windshield base 3 diverts measured airflow to help cool sensitive electronic components under the hood.

Channels integrated with windshield posts 4 intercept rainwater dispersed by wipers, conduct it upward onto roof area 5 and away from side windows.

Outside mirror shell 6 shaped to deflect swirling water, slush from mirror surface.

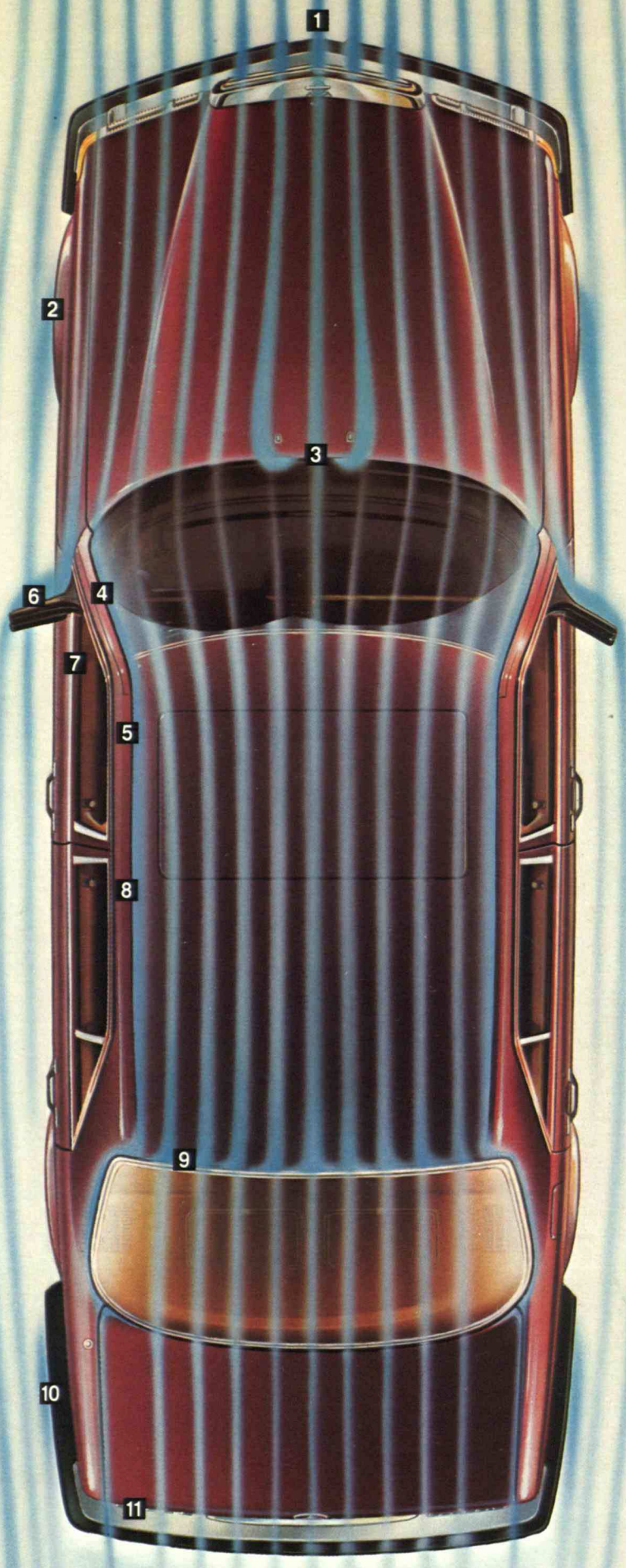
Fine aerodynamic detailing of cabin exterior 7 keeps wind turbulence and noise at minimum.

Channels set into roof 8 help guide rainwater rearward and away from side window area.

Grooves trap streaming rain and duct it around rear window frame 9 to exit at rear of car.

Ventilation gills 10, placed in a controlled low-pressure area at rear quarter panel, efficiently draw stale air from cabin. Air in cabin is completely exchanged every 20 seconds.

"Washboard" ribbing of taillights 11 helps keep their lenses clean, even in foul-weather driving.



The difference between aerodynamics and Mercedes-Benz aerodynamics.

The Mercedes-Benz sedan sweeps through the stormy night along a rainswept highway. Inside the car, stereo music muffles the rhythmic slap-slap-slap of the wipers and everything is normal.

But outside the car, everything is not normal.

The rain is heavy, but the side windows remain oddly unstreaked.

The surface of the driver's outside mirror is almost free of swirling water.

Sheets of rain should be streaming down and over the rear window glass, but they aren't.

Enough grime is kicked up as the car whisks along to cake the taillights. But the taillights still glow ruby red.

Something strange and wonderful–and aerodynamic–is happening to this Mercedes-Benz.

0.36 not enough

It is happening by design.

There is, of course, no more aerodynamically pure four-door sedan sold in America than the Mercedes-Benz 300SD Sedan. Its 0.36 drag coefficient eclipses many exotic sports cars and coupes in sheer wind-cheating efficiency–a crucial feat, when every gain of 10 percent in aerodynamic efficiency can yield a gain of three to four percent in fuel economy.

But for Mercedes-Benz engineers, it is only step one in the exploitation of aerodynamics. They look beyond the numbers game of low drag coefficients, to the way a moving car and the moving air around it interact. They use the flow of onrushing air, as it passes over and around the car, to perform vital extra functions.

In brief, they put aerodynamics to work. Extending the science of cheating the wind to include the idea of *harnessing* the wind.

Study the diagram at left. As that Mercedes-Benz sedan forges ahead through the storm, aerodynamic science is being used to sluice rainwater away from its side and rear window glass.

The shell of its outside mirror has been aerodynamically shaped to help conduct swirling rain and slush away from the mirror surface itself.

The taillight lenses are deeply ribbed to resemble washboards: not a styling trick but an aerodynamic trick, meant to keep the recessed grooves clean by sheltering them from the vortices of airborne water (and mud and slush) in the car's slipstream.

Aerodynamically stable

Wet weather or dry, aerodynamics helps to exert a constant *downforce* on the front axle of a Mercedes-Benz as it moves along–countering a natural tendency of the front end to "lift" as speeds rise and more firmly bonding the tires to the road.

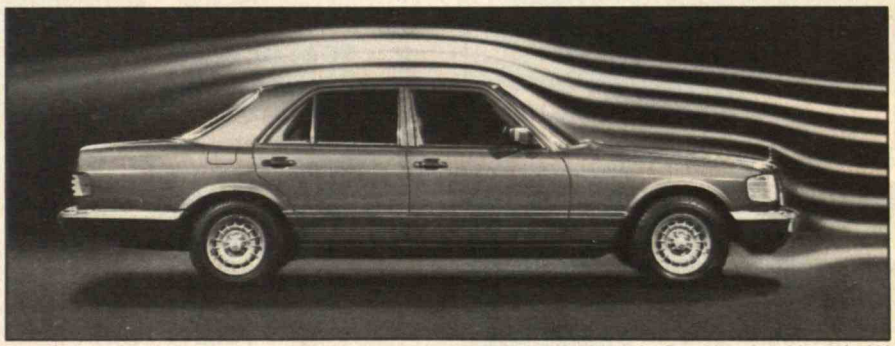
The car's body side configuration is aerodynamically critical. Correct shaping can help resist the sudden force of violent sidewinds, invisible blows that could jar a car off its true path.

A Mercedes-Benz utilizes aerodynamics to continuously cool specific heat-sensitive electronic components under its hood. To feed fresh air into the cabin while silently extracting stale air. To prevent irritating drafts and pressure imbalances in the occupants' ears, by maintaining a constant level of cabin air pressure at all speeds. To draw exhaust gases away into the airstream behind the car.

A Mercedes-Benz also employs aerodynamic science to help calm its driver's nerves. Even the outside mirror is shaped to generate minimal wind noise; if the driver experiences an almost eerie absence of wind buffeting and howling as he drives along, credit the presence of rigorous aerodynamic detailing.

Mercedes-Benz believes that cheating the wind in the cause of more fuel-efficient driving is good. But Mercedes-Benz believes that both cheating the wind in the cause of fuel efficiency *and* harnessing the wind in the cause of driving efficiency is better.

And that is the difference between aerodynamics and Mercedes-Benz aerodynamics.



Engineered like no other car in the world

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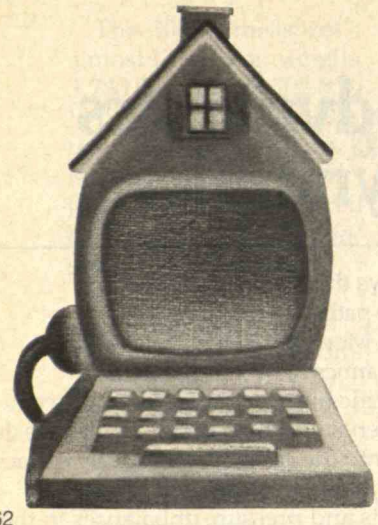
TechnologyReview



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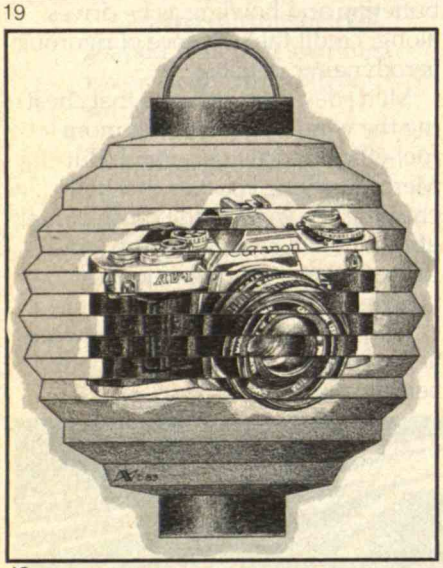

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How neutron scattering entirely new polymer

Exxon Chemical's David Lohse can observe the structure and behavior of polymer molecules.

From easy-care fabrics to the nose cones of space vehicles, the long chain molecular structures called polymers have become, both literally and figuratively, woven into the fabric of 20th century life. Now, Exxon's David Lohse is exploring the characteristics of polymers to extend the potential of these remarkable materials.

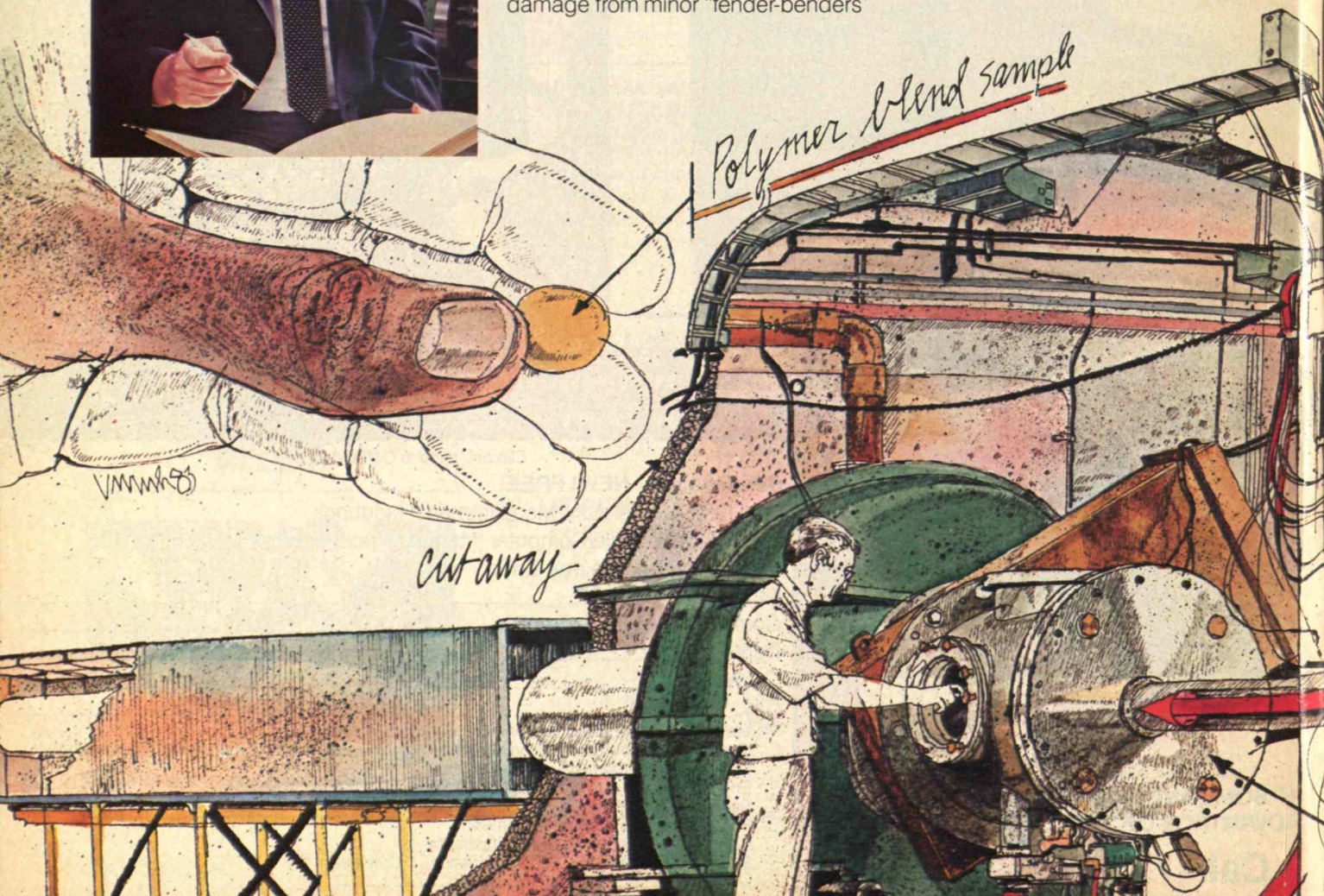
Polymer Blends

Combinations of polymer molecules can produce materials with better properties than those of the individual components. Exxon Chemical developed and is currently marketing, for example, a blend of plastic and synthetic rubber polymer material which has the formability of plastic and the elasticity of rubber. Used in automobile bumpers, this material helps reduce damage from minor "fender-benders" by absorbing impact and then returning to its original shape.

In order to develop more sophisticated blends, David Lohse and others in Exxon Chemical's Long Range Polymer Research Group are developing the use of Small Angle Neutron Scattering (SANS), a technique that subjects these molecules to detailed scrutiny.

Small Angle Neutron Scattering

Conventional electron microscopy techniques allow scientists to study the structure of a polymer blend at room temperature. But the technique, used by Exxon at the National Center for Small Angle Scattering Research (Oak Ridge National Laboratory) and at the National Bureau of Standards in Mary-



is helping Exxon create materials.

land, permits scientists to study polymer molecules at temperatures of 180°C or higher. This is crucial, since it requires high temperatures for the polymer to melt and be processed. In this melt state, the molecules are most mobile and the structure of the blends is formed.

Seeing Polymer Structure by SANS

Small Angle Neutron Scattering involves the same basic physics as other types of scattering such as light or X ray. A well-collimated beam of neutrons is directed onto the sample. Some of the neutrons are scattered due to interactions with the atoms in the sample. The angle of the scatter is determined by the size of the molecular structures. Different structures can be labeled by substitutintg deuterium for hydrogen atoms, which allows a single polymer chain to be "seen" in its environment.

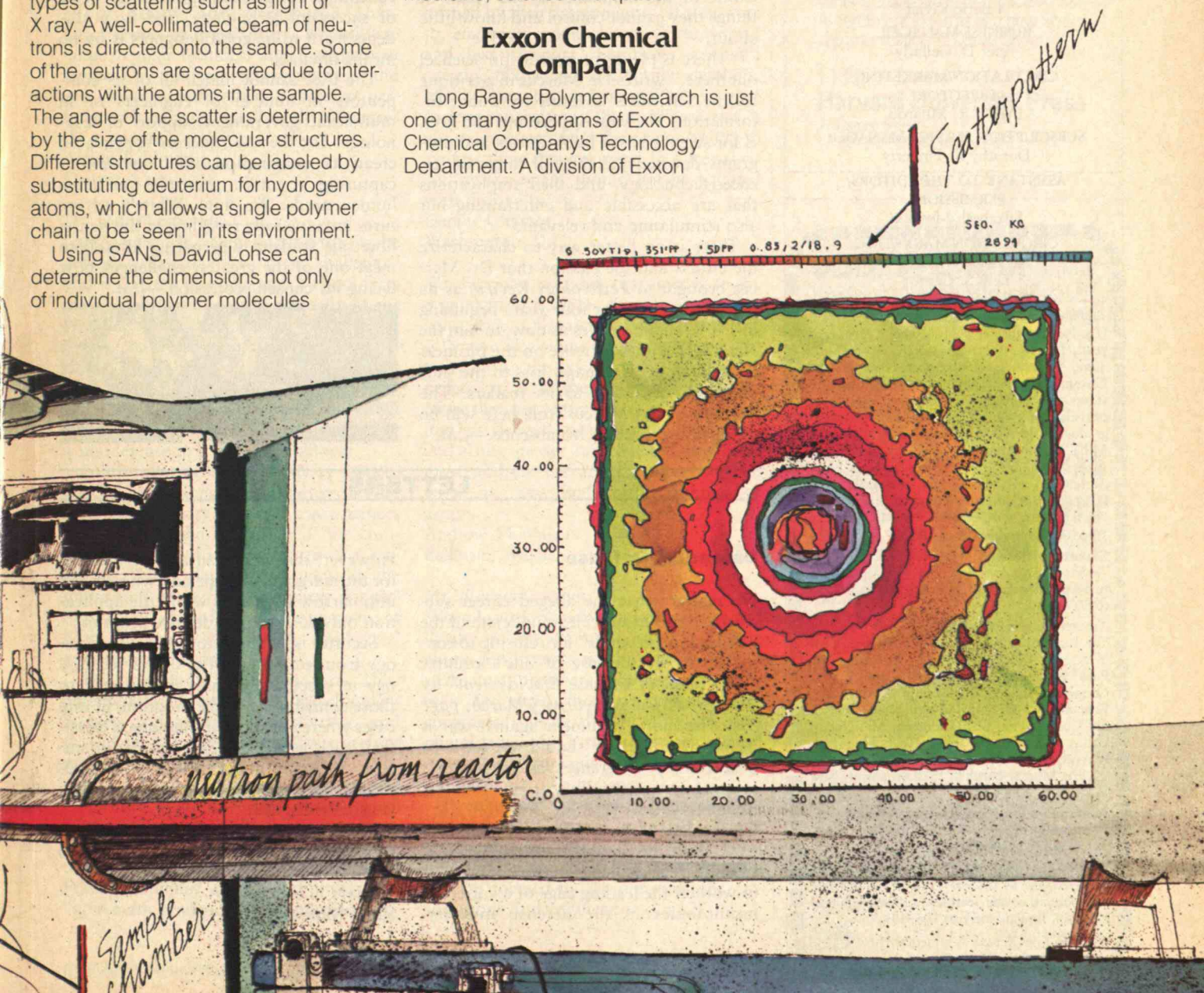
Using SANS, David Lohse can determine the dimensions not only of individual polymer molecules (10-100 angstroms) but also the dimensions of the phase domains of the blends (greater than 1000 angstroms). More importantly, while the blends are being heated, he can measure changes in the sizes of the individual molecules and the domains. It is these changes which determine the physical properties of the materials.

The information obtained using SANS will be used to develop new polymer blends that may find important commercial applications in the home, in industry, medicine, science and space.

Exxon Chemical Company

Long Range Polymer Research is just one of many programs of Exxon Chemical Company's Technology Department. A division of Exxon Corporation, Exxon Chemical is the world's ninth largest chemical company. Its research activities are diverse, with 2,000 scientists, researchers and technicians located in 10 countries working in advanced fields of catalysis and polymer science, and on ways to produce chemicals from new feedstocks or from more efficient processes.

EXXON



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FIRST LINE

Missing Marcus

Why the recent growing attention to science and technology in the media—new magazines, science pages in newspapers, ever-richer programming on public television? Because, says Steven J. Marcus, "people have become increasingly concerned that the ubiquity of science and technology in their lives—whether it involves benefits or risks, the exotic or the mundane—is the result of things they cannot control and know little about.

"There is plenty of interest [in science] out there," writes Dr. Marcus in a critique for the Scienstists' Institute for Public Information. The vital opportunity, he says, is for science-based publications and programs devoted "to the full range of science, technology, and their implications that are accessible and entertaining but also stimulating and relevant."

There is no better way to characterize the efforts and the passion that Dr. Marcus brought to *Technology Review* as its managing editor for four years beginning in 1979. That he leaves us now, to join the *New York Times* to write on the business of technology, is a major loss to the staff of the *Review* and to its readers. The strength of Dr. Marcus' role here will be especially realized in his absence.—*J.M.*

Pepper White's Challenge

It's a mixture of high suspense and high comedy, complete with a few nondeleted expletives. So why is an article with these attributes by M.I.T. graduate student Pepper White—"*Learning Design: There's No Fooling Mother Nature," page 19*—filling so many pages of this issue?

Partly because Pepper White is an insightful and candid observer of himself and his surroundings—which happen to be engineering education. He applies these talents to chronicling a crucial (and often underestimated) part of his engineering education. For good design is at the heart of successful technology, and how students learn to be good designers is by no means obvious.

The U.S. cannot match all of its competitors in number of engineers or in monolithic government support of technology. For the U.S., success depends on creativity, imagination, and innovation in capturing scientific principles to serve human needs. We think White's adventures are especially revealing in this sense: how one student is preparing himself to meet one of the greatest challenges now facing his chosen profession.—*J.M.*

LETTERS

Defending Defense

No matter what the alleged career sacrifices, I find it difficult to understand the "clear moral grounds" for refusing to contribute to the defense of one's country (*"The Perils of Defense Employment" by Warrren F. Davis, February/March, page 23*). The moral argument against war is incontrovertible; we should not let it be obscured by differences as to the best means for its prevention.
Rene H. Miller
Cambridge, Mass.

I found great challenge in the opportunity to work at the leading edge of a variety of technologies in the defense industry. However, this work can also be a haven for the marginally competent, who are put into narrow specialties with little application outside a specific defense program.

Security is not used to conceal technology from employees. The use of technology in specific programs is restricted to those contributing to the program. In rare cases where advanced technology is classified, such as the design of fuses for nuclear weapons and cryptographic algorithms, the application to private industry is usually distant.

The defense industry has served our nation well and provided opportunities to those who worked in it.
William F. Steagall, Sr.
Santa Monica, Calif.

My own experience has been the opposite of Dr. Davis'. Had I remained in my teaching job after completing my thesis, I would still be working in reinforced concrete. This has happened to those with whom I graduated who chose that route. Instead, during my years in the defense industry, I acquired experience in dealing with shell buckling, composite materials, filament winding, pressure vessels, crack propagation in materials, shock propagation in soils, strategic exchange studies, small-program and laboratory management—and reinforced concrete.

Far from having an infinitely large R&D budget, we are required to justify every penny and prove the cost-effectiveness of every effort. We still undergo regular technical and management reviews by military representatives and are under considerable pressure to perform well because this directly influences the company's profit.

Arthur Feldman
Denver, Colo.

Dr. Davis responds:
I agree with Mr. Steagall that work in the defense area can be a "great challenge" and is "at the leading edge." These facts make it difficult to look critically at the long-term implications of a career in defense. Challenge is not a characteristic of defense work alone. All other things being equal—pay, challenge, state-of-the-art work, job security, recognition, and other incentives—most jobseekers would prefer a nondefense to a defense employer.

I did not state that security is used to conceal technology from employees. I did argue that security has other consequences that work to the advantage of the company and the disadvantage of the employee. While many people consider the imposition of secrecy on society dangerous and ill-advised, many are unaware of how such secrecy restricts employees' constitutional rights.

Dr. Feldman's impressions that defense-related research and development budgets are somehow cost-effective, and that civilian and defense markets are not qualitatively different, are simply unrealistic. The extravagances, failures, and limitations of large weapons systems such as the M1 tank and the F-18 aircraft are well-known. For example, in recent testimony before Congress, Pentagon analyst Franklin Spinney described the military's "systematic tendency to underestimate future costs" and "planners [who] become desensitized to cost growth over time." This pattern extends all the way down to hand weapons. The artificial nature of military markets on the one hand and the objective of performance-before-cost on the other render the concept of cost-effectiveness meaningless when applied to defense procurement.

Free Thought

In "How Engineering Is Like Baseball" (*January, page 8*), Samuel Florman states that "engineers' attitudes are largely formed by their assignments." If that were so, engineers would deserve little respect and less support. Engineers are still citizens, taxpayers, and family members. Ideally, corporate actions will be such that society can support them. Where this is not so, engineers have the responsibility to express their disagreement. In a free society, disagreement should not be equated with disloyalty.

Dennis Chamot
Washington, D.C.

Mr. Florman preaches that loyalty to the organization is better than a questioning conscience. Our society is a result of the collective decisions of its members. No one can use the excuse of "just following orders" to avoid making moral decisions. More than any other profession, engineering has devised means for concentrating and using power and energy. Engineers must address the consequences of their work as individuals rather than as a group.

Andrew M. Valaas
Bellevue, Wash.

Mr. Florman replies:
When I speak of individual conscience and loyalty to the group, I am not talking about good versus evil but rather how to strike an appropriate balance between the two. Too often, those who speak about conscience ignore the morality of communal endeavor. I tried to stress the need for cooperation while explicitly noting the ultimate role of conscience.

If engineers' attitudes are formed by their roles as "citizens, taxpayers, family members, and members of local communities," why shouldn't their attitudes also be formed by their professional associations and engineering work?

PHOTOS: CALVIN CAMPBELL; BRUCE JOHNSON

ROBERT COWEN

The Not-So-Hallowed Halls of Science

A few decades ago, banquet speakers at scientific conferences regularly lauded the ethical purity of scientific research. They assured us that if politicians were as objective, honest, and self-policing as members of the scientific community, the world would be a better place. Would that scientists were so virtuous! The widespread occurrence of fraud, deceit, and plagiarism that has come to light over the past decade shows these sins to be as scarlet as city hall's. Science has been revealed as the very human, career-oriented, temptation-ridden pursuit it is. Now it is time to establish reasonable safeguards against the malfeasance that, far from being the aberration many scientists appear to consider it, is endemic to modern research.

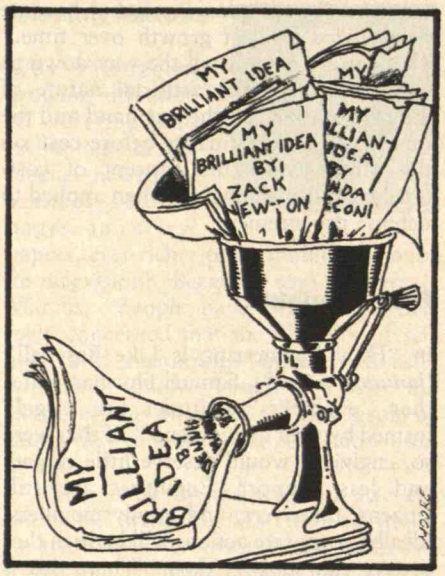
Science writers William Broad and Nicholas Wade have made this point forcefully in their book *Betrayers of the Truth* (Simon and Schuster, 1982), examining a number of well-documented cases of fraud, plagiarism, and deceit. Some are ancient—Newton fudged his numbers, Ptolomy stole some of his data. Most are modern, including some reported within the past two or three years. Broad and Wade convincingly demonstrate that faking of data and stealing of research papers are widespread and continuing practices, not just a nuisance created by a few atypical individuals.

Looking the Other Way

The incentive to cheat arises from the need to climb career (tenure) ladders, work in high-pressure laboratories, and compete intensely for prizes, research grants, and sometimes patents. The opportunity to cheat is afforded by the lack of detailed supervision of junior workers, the tendency of joint authors to trust the work of colleagues, and the sheer mass of publication, much of which collects, largely forgotten, in libraries.

By recycling some of these papers, one enterprising medical researcher promoted himself into posts at a number of leading

ROBERT C. COWEN is science editor of the *Christian Science Monitor* and former president of the National Association of Science Writers.



U.S. biochemistry labs even though his academic background was shaky. He amassed a long list of published papers simply by copying a mediocre paper in one obscure journal and sending it under his own name to a second obscure journal.

But as authors Broad and Wade point out, obscurity is not essential to success. Clever operators can get away with outrageous fraud even in active research areas that attract worldwide attention. One such researcher at Yale both plagiarized someone else's work and fabricated his own data. Yet even the distinguished scientist who co-authored some of his papers was reluctant to recognize the fraud until independent audits forced him and university authorities to do so. In another case, a young man was accepted as a graduate student at a leading laboratory and soon became a world-recognized authority to whom veteran researchers looked in awe. He had a golden touch that could produce dazzling research results that others found hard to duplicate. A Nobel Prize was mentioned. Yet it turned out that his data were faked, and investigation revealed that his undergraduate record included a conviction for check forgery.

The authors recount many such cases and undoubtedly have more in their files, as do all science writers. Broad and Wade are correct in saying that researchers have been reluctant to recognize that the scientific enterprise no longer lives up to their idealized image, if it ever did. The honesty that is presumably forced on researchers by the need to publish results that others can use and replicate is a myth, given that much work never receives such outside scrutiny. The review system for papers fails when reviewers take too much on faith or, worse, when they themselves are stealing from the papers they review, as happened at Yale.

Enforcing Scientific Truth

Science has become a massive, career-oriented profession, like medicine or the law or, dare one say it, politics. And like these other professions, it too needs institutionalized safeguards to deal with the fraud and deception that, while minor compared with the bulk of scientific work, have nevertheless become a continuing problem.

The Broad-Wade book makes several timely recommendations. The authors urge universities and research institutions to set up formal procedures for dealing with accusations of fraud. They also suggest that co-authors take more responsibility for joint papers and that lab chiefs know the work of subordinates well enough to detect fraud. They wisely note: "Two principles should be established. First, all people named as authors should have made a definable major contribution to the work reported. Any minor contribution should be explicitly acknowledged in the text of the article. Second, all authors of a paper should be prepared to take responsibility for its contents in precisely the same measure as they stand to take credit. . . .

"If a lab chief is not close enough to a research project to know whether data is being falsified, he should not put his name on the paper. For the papers he does sign, he should take full responsibility. To most nonscientists, such principles probably seem too obvious to be worth stating."

Obvious perhaps, but they still are not standard in the scientific community. Many a lab chief still signs papers to hog credit. And in some cases of fraud, such supervisors have retreated behind pious statements, saying that they had to have faith in their coworkers and thus couldn't pry into the research even though they did not hesitate to sign the reports.

Happily, universities are beginning to respond to the need to tighten up. Last fall, Yale University announced a formal plan for dealing with research fraud. The

Continued on p. 85

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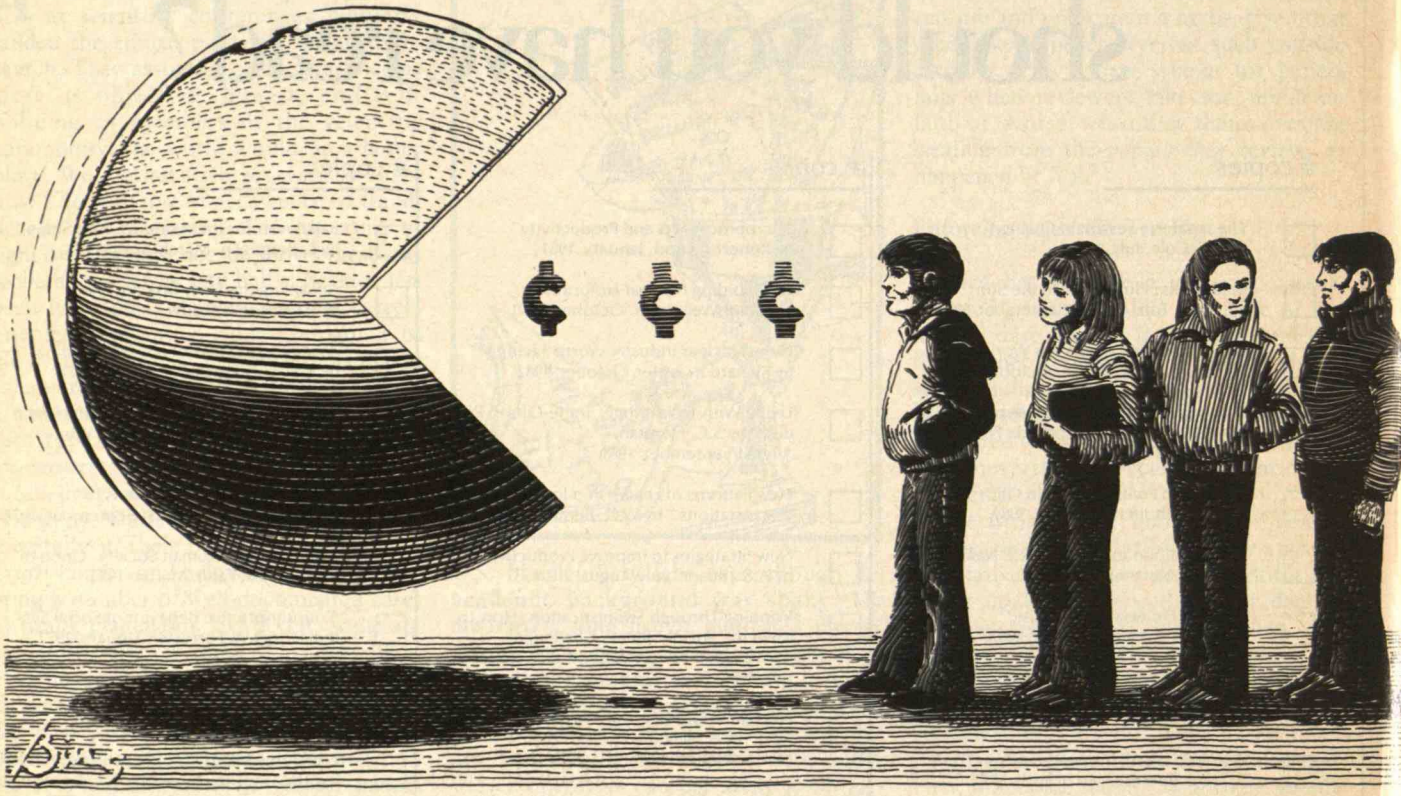
BY CAROLYN MEINEL

Will Pac-Man Consume Our Nation's Youth?



WHEN I was a teenager back in the sixties, parents used to worry that we'd get into a head-on collision with all the drag racing we did. Then, after the Twist came out, the big thing was to get pregnant after the sock hop just in case the traditional post-football-game rumble got too boring.

With college, LSD flashed onto the scene along with the Weathermen. What with chugalugging Romilar cough syrup and mixing ammonium nitrate with 6 percent fuel oil for political impact, the younger side of the generation gap disrupted many a parental nervous and digestive system.

Today I have teenagers of my own to bail out of jail, but all they want to do is play Pac-Man. Yet just when my kids' fascination with video and computer games was about to allow me to sigh with relief, a legion of professional worriers popped up with the news that all high technology has brought us is a new brand of adolescent misbehavior.

The biggest gun among the anti-video-game forces is U.S. Surgeon General C. Everett Koop. At a conference of public health workers held at the University of Pittsburgh last November, Koop blasted those amusements as one of the top three causes of family violence, along with TV and economic hardship. "Everything is zapping the enemy," he complained, warning that "kids are great mimics."

Koop's warnings on the hazards of explicit TV violence are documented by extensive research done during the 1960s and 1970s. For example, many studies have found a connection between heavy TV viewing, particularly of violent programs, and overt aggression shown by children and adolescents, says Dorothy Singer, co-director of the Yale University Family Televison Research and Consultation Center. Children learn aggression, Singer says, by observing and imitating physical acts, disobedient attitudes, and verbal attacks.

However, there is scant evidence to support Koop's assertions on the hazards of video games. Unlike TV, such games are typically highly symbolic with no actual portrayal of blood and guts. Like chess, the figures zapping one another on the video screen are stylistic images that bear little resemblance to human forms.

"I know of no research that implicates video games," says Dr. Judy Martin, head of Child and Youth Specialization at the University of Pittsburgh. "Of more concern to me is the general societal acceptance of violence." Martin reports that in a nationwide door-to-door sampling of 2,143 households conducted in 1976, many people said they believed "a good swift hit was the ultimate way to make a kid respond."

A Special Kind of Paranoia

In the meantime, people short on psychological expertise but long on enthusiasm for computers are going after video-game detractors. Jon Freeman, vice-president of Automated Simulations, whose software for home computers offers struggles to the death with everything from extraterres-

ILLUSTRATION: CHRISTOPHER BING

trials to poison spores, insists, "I find it hard to believe that playing an arcade game will make kids more aggressive than playing cops and robbers."

And Joe Clayton, a technical writer specializing in manuals for nuclear submarines, pooh-poohs predictions that games such as Missile Command, which inevitably terminates in mass nuclear destruction, will induce Strangelovian behavior in today's youth. "It takes a special paranoia to produce such a fear," Clayton asserts. He derides warnings such as those voiced by Morningside College Professor John Shelton that our credibility as a peaceful nation will be compromised "if a substantial portion of our citizens are addicted to fantasies of nuclear warfare."

However, Shelton's fears are echoed by Dr. David Felty, a pastor at the Campus Christian Center in Tucson, Ariz., who specializes in the ethics of technology. Felty says of Missile Command enthusiasts, "If they look like one [a nuclear war enthusiast], sound like one, and act like one, then they are one." Felty, who insists he feeds quarters to Missile Command only in conjunction with essential field research, reports that other players resort to "Vietnam-style language such as 'wasting' cities."

Vice or Virtue?

Some opponents of the video-game craze see the best minds of the next generation being destroyed by the computer. They point to evidence that devotees will resort to anything to feed their habit. This February, police in Tokyo nabbed a five-boy video gang that had stolen an estimated $39,000 in cash and jewelry to bankroll their habit. In South Florida, some residents have complained that the opening of video arcades seems to correlate with an upsurge of petty theft. Police in Ft. Lauderdale have, in fact, reported a few complaints that children are stealing quarters from "mommy's" purse.

Others, however, point out that at least young people are doing something basically harmless with their money. "It's a good substitute for bad vices," Don Fudge, head programmer at Avant-Garde Creations, asserted at a recent Applefest for microcomputer enthusiasts in San Francisco. Fudge speculated that the quarters teens pump into arcade games might otherwise be spent on drugs.

In the meantime, alarmed citizens, unswayed by the pro-video arguments of programmers and submarine manual writers, have tried to zap the trend. As early as 1977, the town of Mesquite, Tex., banned minors from playing coin-operated games unless accompanied by a parent. The U.S. Fifth Court of Appeals later ruled the ordinance unconstitutional.

Boston, the cradle of bans, is trying to come up with a constitutionally acceptable weapon against computerized amusements. Consumer Affairs and Licensing Commissioner Joanne Prevost has proposed zoning to restrict coin-operated games to business and industrial areas, safely out of the path of most teens. Over in Cambridge, Mass., some people who style themselves the "Harvard Square Defense Fund," together with other local groups, have managed to ban a video-game arcade from the Square.

In South Florida, video games have become the strategic focus in a cross-generational war pitting retirees against teens. In the suburban community of Tamarac, for example, hundreds of elderly activists converged on City Hall to protest a zoning change that would have allowed Tamarac's first video arcade to open.

"I think the main thing is the gathering place the games create for young people," Coral Gables Mayor Ed Heafy said, in explaining the opposition of his constituents to such arcades. "Let's just ban teens," *Miami Herald* columnist Doug Delp said in a recent editorial. "That's what this is all about anyway."

In an attempt to reverse this trend, state legislators in New York introduced a bill last year to ban the banning of video games—to the applause of chronic adolescents such as me. As the mother of four Pac-addict daughters, I say to the anti-video-game prissies, let them eat Space Invaders! Why doesn't the surgeon general warn us that the kid who forks a queen with a rook today will be holding the principal and the playground monitor hostage with a zip gun tomorrow?

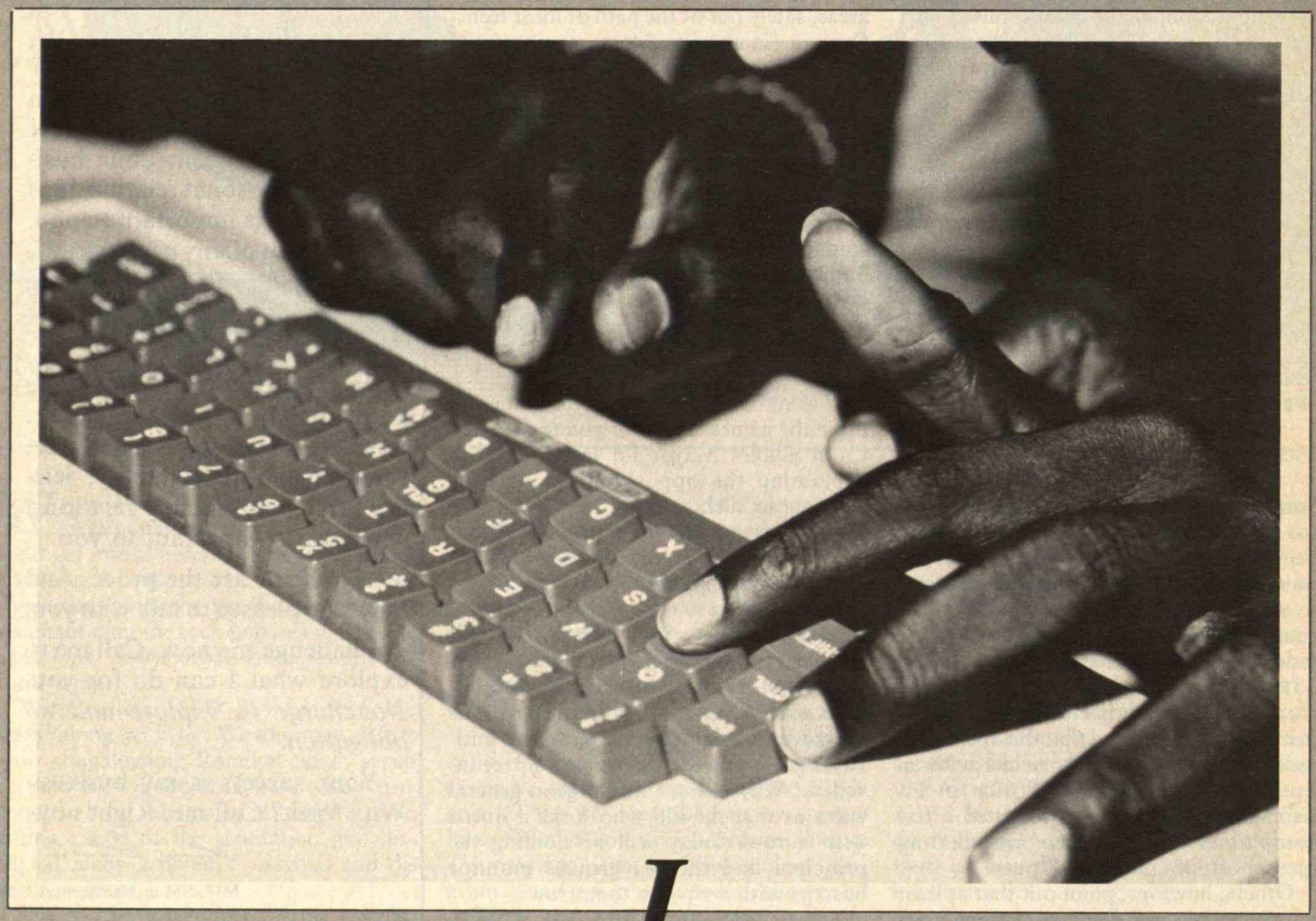
The Perils of Silicon

I first introduced my kids to computer games back in 1974. It was the Plato system, a nationwide interactive computer network. The kids learned to add fractions by mixing chemicals to grow monsters on an orange phospor screen

(continued on page 28)

Computers and a New World Order

BY JAMES DRAY AND
JOSEPH A. MENOSKY



Is adapting computers to the various cultures of the world an idea whose time has come or a pipe dream with commercial overtones?

AMID the popular utopian visions of the world's computerized future are some troubling questions about who really will benefit. Must the computer revolution widen the gulf between rich and poor? Will it only perpetuate technological elites?

In reaction to such concerns, the French government has established a research group whose goal is to start a revolution of its own. The World Center for Microelectronics and the Human Resource ("Centre Mondial Informatique et Ressource Humaine") in Paris supports a cadre of scientists who are studying—and suggesting ways to change—the computer's impact on people and societies. The scientists ultimately envision the widespread use of computers by ordinary people in all countries, making them an integral part of human culture. In particular, they hope to transfer microcomputers to Third World countries and the poorer regions of industrial countries. They also hope to design computer languages, software, and hardware simple enough to make the machines truly useful to their recipients.

French President François Mitterrand opened the center early in 1982 with a good deal of fanfare and a budget for the year of $20 million. Since then, the budget has been cut by almost half, the staff has undergone a devastating shakeup, and the program itself has provoked considerable controversy. Now its future is uncertain, and the center remains an intriguing mix of science and politics, savvy and naivete, technical solutions and world-class problems.

Among its founders were Jean-Jacques Servan-Schreiber, the French writer, publisher, and politician who is the center's president; Seymour Papert and Nicholas Negroponte, computer scientists from M.I.T. who took leaves of absence from their academic posts to become the center's directors; and a number of other top computer scientists, educators, and socially active intellectuals. From the beginning, then, the center has been driven by the ideas of a disparate group of people—above all by Papert's vision of the computer as an agent of intellectual freedom, and by Servan-Schreiber's ideal of a new world order based on access to information and high technology.

Over the past decade, Papert has guided

In the West African city of Dakar, Senegal, schoolchildren use the computer as an "instrument to learn everything."

the development of a sophisticated computer language, called "Logo," for use as a learning tool. (He wrote about the experience in a book for a popular audience, *Mindstorms*, published in 1980.) His studies of children grappling with Logo convinced him of the radical effect computers could have on the way children learn to reason, and on their subsequent ability to deal with novel situations and complex problems.

Papert thinks that even very young children and uneducated adults can master difficult intellectual concepts if a computer is used to convey the ideas to the learners. For example, he recalls that, as a child, he was fascinated by gears. Later, when he was introduced to algebraic equations in school, he was able to understand them by thinking of an equation as a gear. He writes, "By the time I had made a mental gear model of the relation between x and y, figuring out how many teeth each gear needed, the equation had become a comfortable friend." Papert believes that just as the gear acted for him as a "transitional object," a computer can serve the same function. "Because it can take on a thousand forms and can serve a thousand functions, it can appeal to a thousand tastes," he says.

This potential of computers to alter radically the nature of education and work remains unexploited, Papert argues, because "our society consistently casts computers in a framework that favors the maintenance of the status quo." To counteract this emphasis, he would like to see "alternative computer cultures": minority groups, women, or poets, for example, who would adapt microcomputers to their own interests and needs.

Servan-Schreiber took up some of Papert's themes in his book *The World Challenge*, published in 1981. He claims that countries of the Third World will eventually join together to confront the developed world with a demand for high technology. He argues that former colonial powers have a moral obligation to help developing countries take advantage of the microcomputer's social and economic potential, and that failure to do so will worsen North-South tensions and lead to worldwide political upheavals. But with the assistance of the advanced technological powers, Servan-Schreiber says, Third World countries might someday even "jump above industrial society into the new information society."

The transfer of microcomputer technology that Servan-Schreiber proposed was to be implemented along the lines Papert had suggested for alternative computer cultures, but his full vision goes far beyond. First, individuals who have used the Logo system to learn new ways of thinking would band together in local groups to solve common problems. For example, farmers in a small Third World community could use computers to keep better tabs on the availability and distribution of supplies. Moreover, the very act of "exploring" with the computer could engender a flexibility of thought that would, in turn, allow the farmers to find novel ways of combining the efficiency of modern agricultural practices with their traditional cultures.

The next step is for communities to widen their knowledge and power bases by linking up, via satellite, with similar communities across a wide region. For example, farming communities could pool their experience about the success of new agricultural techniques so that each farmer need not start from scratch. Fi-

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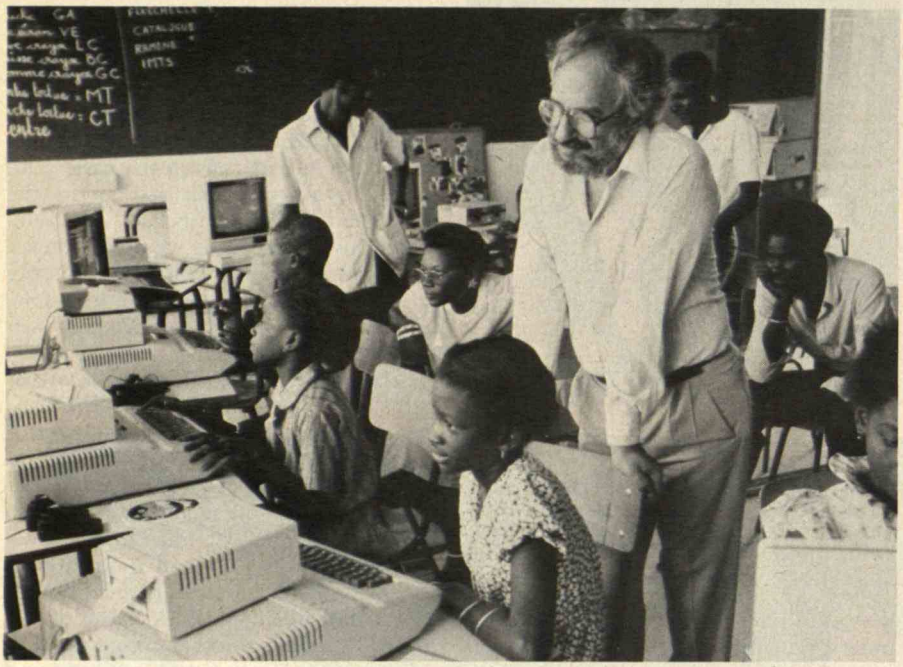
PHOTOS: ROBERT MOHL AND ROBERT LAWLER



Seymour Papert thinks even young children and uneducated adults can master difficult concepts via computers. He spent a decade developing a computer language called "Logo" for use as a learning tool. Here he's using it with children in Dakar, Senegal.

nally, networks of communities could become a new social force, with political and economic systems changing accordingly. Within a developing country, this might mean that historically disenfranchised groups could gain enough power to demand a more equitable distribution of rights and resources. And in Servan-Schreiber's ultimate vision, the entire Third World would become an electronically linked network of countries ready to cooperate or compete with developed nations.

The Politics of Computer Cultures

The center has so far devoted much of its budget to trying computers at two test sites: the West African city of Dakar, Senegal, and Marseilles, France.

In Dakar, a team from the center is working with government-sponsored educators and computer scientists to adapt microcomputers to many aspects of Senegalese life, including industry, agriculture, and medicine. The team has begun by tackling the educational system, and the first project has elementary school children learning to program computers using a French version of Logo. (French is the European language spoken most widely in Senegal.) The system is also being adapted to the local culture, beginning with the translation of Logo programs into Wolof—one of the major Senegalese national languages—which many children speak at home. Once children have mastered the basics of computers, they can use the computer as what Papert calls "an instrument for learning everything," particularly science, mathematics, and language.

Robert Lawler, an educational expert at the center and longtime colleague of Papert's, demonstrated to one of us how a prototype program in Wolof can help children learn language. First, Lawler typed the Wolof word for "sun," just as the children would do when taught to spell it by their teachers. An image of the sun appeared promptly on the screen. Then he instructed the computer, again in Wolof, to put the sun in the sky, and the image on the screen moved up. With a few more commands, the screen soon showed the sun rising over a man as he walked to his house. The computer adds a visible "reality" to keyed words, and Logo permits even young children to add new words and designs to such "microworlds." It is this simplicity, feedback, and adaptability for the individual that Papert and others believe can change minds in fundamental ways—and that make the Logo language suitable for many cultures that would otherwise be out of reach of computer technology.

In Marseilles, researchers from the center are preparing for the delivery of some 500 microcomputers this year to schools, houses, and social-service agencies in a working-class district with high unemployment. In effect, the project will be a large-scale laboratory experiment in creating a "computer culture." The team will study the impact on the community and work with the residents to help them adapt the computers to their own needs. Project staffers hope residents will "seize" the microcomputers, bringing the machines into their lives "as a tool, as a game, as a companion, as a mirror." For example, Papert says unemployed young people, especially high-school dropouts, could make use of their easy access to computers to learn marketable skills. Another possibility is that self-employed artisans will use the computers to boost their productivity. For instance, carpenters might use computers to estimate more accurately the cost of jobs, control inventory, and even design their products.

The rest of the 75 researchers employed by the center are working on an array of other projects. For example, some are improving laser videodisk memory technology that will enable "interactive" computers to respond even faster than when equipped with standard floppy disks. Some are developing new programming languages to make computer systems more flexible and easier for untrained people to use. Some are designing durable and compact microcomputers suited for use in remote areas. And some are developing portable "expert" medical systems to assist rural health workers in diagnosis and treatment of disease.

All these projects are still in their early stages, and most seem to be loosely organized and minimally defined. In fact, many of the center's teething pains seem to arise from its slippery mandate and shifts in its objectives. The center's priorities already seem to have been diverted from the project in Senegal and others planned for Third World countries to social programs that could relieve un-

People outside society's mainstream may indeed find creative new uses for computers, but will this really usher in a new world order?

employment in France, and then to research to make the French telecommunications system stronger. "The center is terribly sensitive to the winds of French politics," Lawler says. "There is no buffer between research and the pressing needs of the French nation."

The center's political volatility contributed to Seymour Papert's resignation, in a flurry of publicity, last December. (Since then, Negroponte has announced that, in August, he too will leave.) Papert charged that Servan-Schreiber was using the center to further his political career and aid the French computer industry at the expense of more humanistic goals. For his part, Servan-Schreiber says that Papert is "a very difficult man . . . interested in only one thing—how to train very young children by computer." But, he adds, "It's not a personal thing for me." Observers say the flap between Papert and Servan-Schreiber turned on personal and philosophical conflicts as well as on their noisier disagreements over how the center ought to be administered.

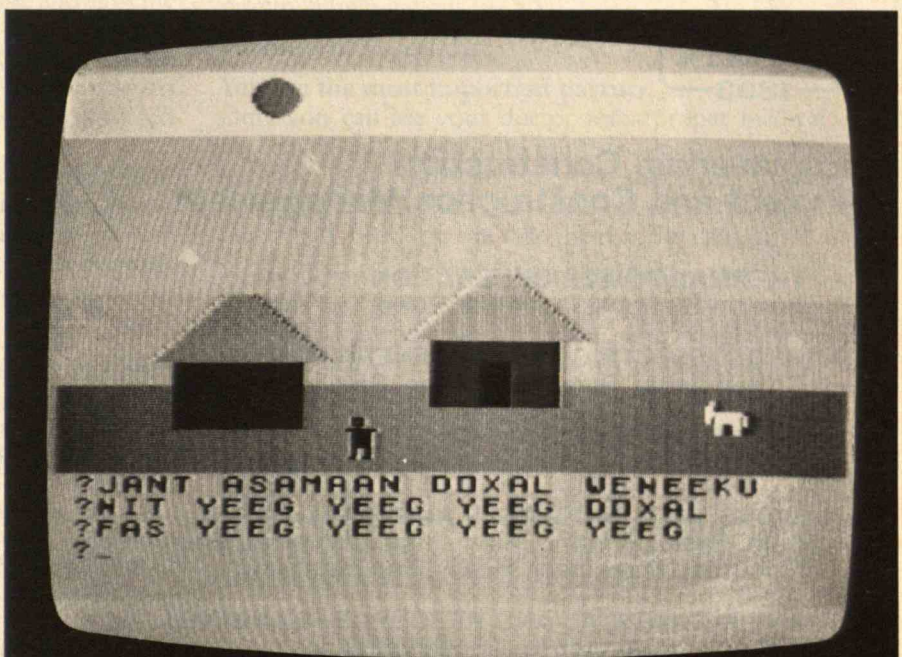
Technological Colonialism?

Problems deeper than these internal matters, however, may prevent the center from ever making significant contributions. An obvious barrier to the transfer of microcomputers to poor and unskilled people is illiteracy; most computer programs depend on written language. One center project has begun to focus on the issue of literacy, and other alternatives are being examined as well. Edward Ayensu of Ghana, who is the president of the Network of African Scientists and one of the center's founding members, claims that it will soon be possible to develop a computer program that understands spoken Wolof. Another suggestion is to design a computer that can recognize physical gestures, allowing for the transmission of a nonwritten, nonverbal "language." But both ideas are pipe dreams, according to Joseph Weizenbaum, a computer scientist at M.I.T. and longstanding critic of the more extravagent claims current in his field. He describes these language programs as "an artificial-intelligence project of absolutely staggering proportions." Weizenbaum argues, "There's no clue to date as to whether these problems are even attackable by any means that we have now."

Critics have also questioned the center's economic, political, and moral premises. For example, American reviewers greeted *The World Challenge* with almost universal disdain, judging Servan-Schreiber's grasp of global economics—and his notion of the Third World leap-frogging its way into the Information Age—to be naive at best. As George W. Ball, the undersecretary of state in the Kennedy and Johnson administrations, wrote in the *New York Times*, "Yes, Virginia, there is noise out there, but what you are hearing is not the [Third World] hammering on the gates of Europe [for technology]; it is only Servan-Schreiber pounding his typewriter."

Servan-Schreiber's ideas in *The World Challenge* were based on the promise of Third World solidarity, as evidenced by the strength of the OPEC cartel. But OPEC is now troubled and divided, and the "challenge" presented to developed nations by the Third World's demands for high technology seems less likely to materialize than he predicted. Indeed, Servan-Schreiber dropped all references to such demands when he testified before a congressional subcommittee in mid-1982. Instead, he predicted that "an army of 50 million jobless will appear on the horizon and signal a situation of despair," unless the developed nations seek creative methods of adapting to computers.

Perhaps the most damaging question raised about Servan-Schreiber and the center concerns the conviction that helping Third World countries acquire computer technologies would be beneficial. To many critics, such a goal is an artifact of colonialism, imposing Western values and definitions of progress on other cultures for less than altruistic reasons. Some have charged that the center was founded because Mitterrand's government saw the Third World as a vast market for the French microcomputer industry—a market largely untouched by American or Japanese firms. "This reminds me of times long ago when white Europeans decided that African women should wear dresses and men pants," Weizenbaum says. "One wonders which came first: the desire to help the Third World or the desire to open up a gigantic new market for cloth."



A Senegalese child can manipulate this "microworld" to learn language. The program is in Wolof, one of the nation's major languages, and the computer adds a visible "reality" to keyed words. Here the Wolof words give instructions: roughly translated, *jant* means "create a sun design." *Asamaan* means "put it in the sky," *doxal* "make it go," and *weneeku* "turn it around." The next lines are similar instructions for creating a person and a horse.

Those involved in the center's work reject the charge of colonialism, arguing that they wish only to provide a useful tool with which non-Western cultures can meet their needs as they see fit. "Helping people control the most important technology of our time is not colonialism," Lawler says. Servan-Schreiber bristles at those who speak of colonialism. "It is an insult," he says. "It is the Senegalese themselves who have asked for this."

The leaders of Senegal have indeed asked for the center's help, as have the leaders of many other countries. Concluding that the Senegalese *people* also want microcomputers demands a leap of faith, however. And it remains unclear who will enjoy the benefits and who will bear the costs in Third World countries. The technology may be just as easily—perhaps more easily—used by those in power to increase the distance between rich and poor and to monitor dissidents.

Unlike Servan-Schreiber, Papert has always admitted that life in Third World countries could become harder rather than easier with the introduction of computers. "I don't want to present myself as a computer utopian. The computer in Senegal, or anywhere else, could create a little enclave in which there is very rapid development, ultimately at the expense of everything around. It absolutely could happen," Papert says. But for him, this danger is far outweighed by the possibility for good and the need to prepare for the coming microelectronics revolution.

The Mitterrand government still supports the center, which has a budget of about $13 million this year. The center has restructured its social-sciences staff and has signed an agreement with Carnegie-Mellon University in Pittsburgh to exchange staff and expertise. Raj Reddy of Carnegie-Mellon, a longtime ally of the center, will work part-time in Paris directing its scientific efforts. The center has also inspired other countries—Colombia, Canada, and Japan—to consider establishing similar programs.

Those close to the center are convinced that its efforts will pay off. "Adapting computers to the various cultures of the world is an idea whose time has come," Lawler says. "The center began this effort, and if it doesn't succeed in Paris, it will succeed somewhere else. The idea is too powerful not to work." Indeed, Papert has had some amazing successes with children using Logo, but the demonstrations have occurred in controlled environments under the guidance of talented teachers. Whether his results can be replicated in cruder settings is uncertain.

The center's intention to analyze and possibly predict the computer's social impacts in both developed and undeveloped countries is undeniably noble. And the center's proposed "counter-revolution"—to be born out of locally initiated computer cultures—is tantalizing. Perhaps groups of people outside society's mainstream can indeed find radically different, creative uses for computers. There are modest precedents with other technologies.

The "rap music" now popular is an example. Emerging out of the black communities of New York City, rap music involves a rhythmic, verbal bantering accompanied, in its most elaborate form, by records played on two or more turntables. The "rapper" delivers his or her monologue while a disc jockey manually cuts back and forth between turntables, spinning them backward as well as forward and establishing new beats as the rap proceeds.

This is a radical use of an established sound technology—a significant extension of the limited use for which the stereo turntable was designed. Given that the computer is, in Papert's words, "the Proteus of machines," it is interesting to consider what might result if blacks in Harlem appropriated that technology. But whether this sort of appropriation can be the basis for a new world order is open to serious question. □

5,000,000 have diabetes and don't know it...

You could be one

It's estimated that 5 million Americans have diabetes and don't know it. The early symptoms are vague and may seem minor. As a result, they are often ignored or not taken seriously enough. Yet, if undiagnosed, diabetes can lead to serious complications affecting various parts of the body, including eyes, heart, kidneys, brain or even life itself.

What are the symptoms of diabetes?
There may be none. Or there may be such simple things as an increase in skin infections or a slower healing of bruises and cuts. Also, be aware of excessive thirst or hunger, frequent need to urinate and extreme fatigue.

These symptoms do not necessarily occur all at once and they usually develop gradually. So it's easy to understand how they can be overlooked or considered part of the normal aging process.

It is important, therefore, to be alert to changes in your body and report them directly to your doctor. You have a greater chance of being diabetic if you are over 40, overweight or have a history of diabetes anywhere in the family.

What is diabetes?
Diabetes is a disorder in which the body cannot control the levels of sugar in the blood. Normally the hormone, insulin, regulates the blood sugar level. But if your body does not produce or effectively use its insulin, diabetes results.

Treatment of diabetes.
Diabetes usually can be successfully managed. Some diabetics need no more than weight reduction, the right foods and moderate exercise to bring blood sugar levels under control. And, if these changes are not enough, a simple oral medication is all that may be needed. Today, even those who need insulin can be better and more comfortably managed by their doctors than ever before.

The diagnosis is easy.
But only your doctor can make it. And remember, if you are over 40 and overweight, or have diabetes in your family, you should have regular blood and urine tests. Early diagnosis in adults can lead to better management and fewer problems later on.

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SCIENCE/SCOPE

An infrared sensor no larger than a collar button will be the heart of a seeker designed to improve the ability of future short-range air-to-air missiles to find and track low-flying targets. The sensor is a focal plane array, a tiny hybrid sandwich with infrared detectors on one side, each attached to a silicon signal-processing chip. It senses temperature differences in a scene and creates sharp TV-like pictures. The array is better than existing infrared sensors because it is far more sensitive, it reduces confusion sometimes caused by heavy ground clutter or background heat, and it can see a target in sharp detail rather than home on jet exhaust. Hughes Aircraft Company is developing a chip with 4,000 sensors for the U.S. Navy. It will form one quadrant of a larger hybrid containing 16,000 detectors.

Paperless planning is making its debut to guide assemblers with step-by-step instructions for manufacturing electro-optical hardware. Color video monitors having twice the quality of home TV sets are replacing thick planning books at Hughes. The monitors are used in conjunction with video discs that hold up to 50,000 full-size color pictures, each equivalent to one sheet of planning. The discs store three-dimensional computer graphics or standard video. Assemblers can review still images or sequences showing how a product is to be built. Paperless planning is faster, more accurate, and less costly than conventional methods. It will also reduce manufacturing errors.

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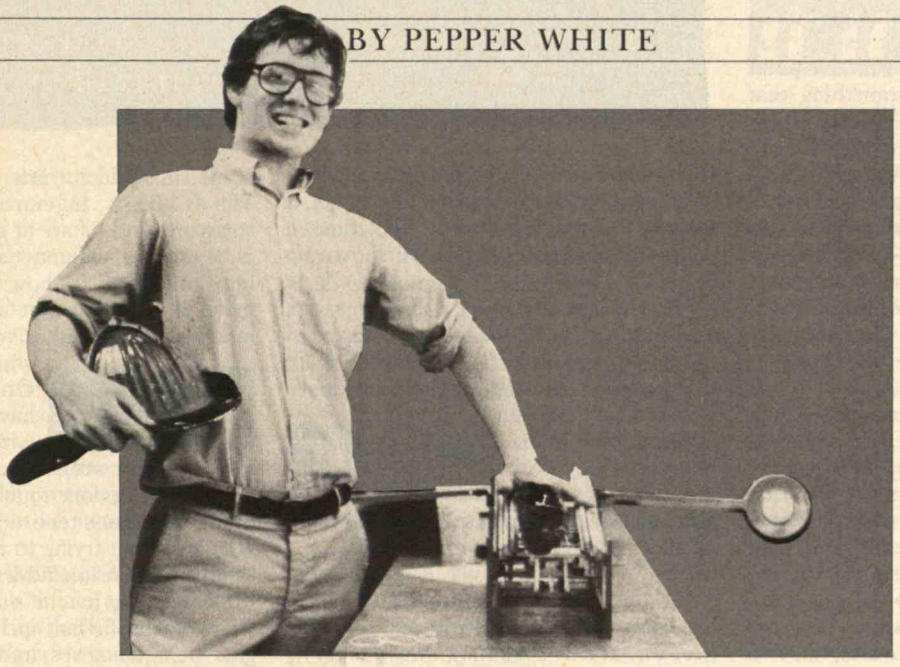
Learning Design: There's No Fooling Mother Nature

BY PEPPER WHITE



Pepper White took M.I.T.'s famous engineering design course because he had to. How could he know that the struggle to build a toy would teach him so much about the agony and ecstasy of the real world?

"THE hooker is," Professor Warren Rohsenow says as he leans back in his chair and cleans his pipe, "if you want to get a graduate degree in Mechanical Engineering, you'll have to take 2.70." Since Rohsenow is chairman of the Department's Committee on Graduate Students, I realize I don't have much choice. After all, 2.70 is probably the most famous course at M.I.T.

"This year's contest will be a little different from those of years past,"

Professor David Wilson tells the class. "You'll have to buy things from a 'store' and we'll give you a 'budget' of $12,500."

In previous years, the course instructors had given everyone the same "bag of junk" and turned them loose. This year, we can "buy" our own materials from a pre-selected stock—as long as we stay within our budget. All I know at this point is that we have to build something that will carry some weight to the top of an obstacle course in just 20 seconds. We can only use a motor from a Polaroid SX-70 camera, together with whatever else is available in the "store." And it all has to be done by November 18—the date of the preliminary trials. I really should read some of those handouts Professor Wilson is passing around.

10·26 "I better get moving on this stupid thing" is going through my head with nagging regularity, so I finally go down to a shop run by a 400-pound technician called "Tiny" and look at the obstacle course. A winding road leads up each side of the course to two scales at the top. There is another route up the middle of the course, but two large plastic "cacti" (that look more like goalposts) have been plunked down to hinder our efforts. The rest of the course is covered with astroturf and some strategically placed tennis balls. The result is a rather bumpy terrain.

The competition will be one-on-one, with each contestant attempting to get his or her homemade machine up the course. The person who gets the most weight to the top in 20 seconds wins.

After scrutinizing the course, I still can't decide what to do, so I check out the shopping list of "store" items. The two-watt Polaroid motor costs $1,000, wood strips cost $250, screws are $50 (good thing these costs are not for real), welding rod is $75 per meter, tongue depressors are $25, rubber bands are $100, and a microcomputer chip is $500. Professor Wilson has already told us that we have to put in some microelectronics because Tony Purnell, Wilson's teaching assistant, "thinks no mechanical engineer should get out of here without having used a wire-wrap tool [to wire a chip] at least once." If the electronics work—by setting off a horn at the top of the scale—we will get an extra 500 grams added to the scale. But right now that is the least of my worries.

When I finish examining the stock, I look at the course again. By that time, a couple of undergraduates have shown up to check it out too.

"I think the side road is definitely the way to go," one of them says. I agree.

"All you have to do is build a little truck that goes up the road," I think out loud. "Or it could go right up the middle underneath one of the cacti. Or you could build a wide off-road vehicle that goes around the cactus, or how about a counterweight system that could get the mass up there like the elevator in the Eiffel Tower?"

We talk a while longer, and they have lots of good ideas too. I go back to my office; the stew is beginning to simmer.

"Why don't you build something that extends an arm up there like a crane?" suggests a friend whom I'll call Ari. Ari has an office next to mine. He is a foreign graduate student who has designed a lot of heavy equipment, and I value his opinion. By building such an arm, he explains, I can avoid the obstacles on the course and still carry some weight to the top. But that adds another dimension to the problem. How can I get something that is supposed to be four and a half feet long (the length of the ramp) into a box two feet long? (Our devices have to be less than two feet long, one foot wide, and one foot deep).

10·29 9:45 P.M.: "A firetruck!" That's what I should build, it comes to me as I'm walking home. I'll build an extension ladder just like that on a firetruck, and the ladder will carry the weight right up onto the scale with no problem.

10·30 At noon I visit the fire station at Lafayette Square to check out how these things work. A huge hook and ladder truck is parked inside. The ladder is an enormous aluminum structure, and I stare at all the cables and pulleys for 45 minutes and can't for the life of me figure out how it works. So I just make a few tentative drawings of the mechanism and leave.

11·5 One advantage of having to meet with your recitation instructor every week is that it forces you to get something done to tell him about, sort of like a progress report. So, I was up till 1 A.M. last night trying to figure out how to build my extension ladder in four sections.

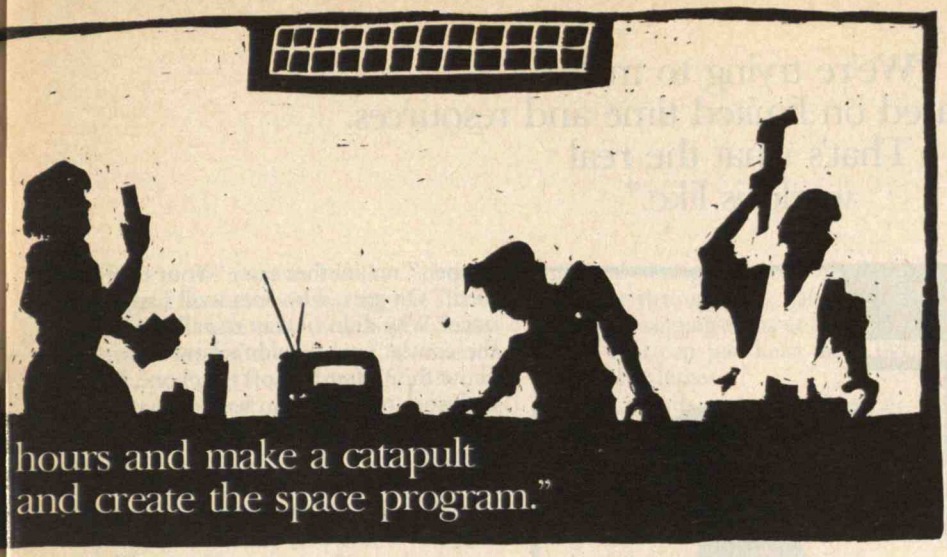
"I'm going to cut the wood into 16 strips, each one-half-inch wide, and then glue pairs of strips into eight L-shaped beams. Two L-shaped beams will form the rails of each section of the ladder," I explain to my instructor, Professor Thomas Bligh. "They'll be pretty strong, and also cheap and easy to make." People are already starting to call the materials cheap or expensive, as if the assigned "costs" had real meaning.

Already little design details start popping up. How many cross-braces or rungs should I put in my ladder? How wide should it be? How will I extend it? It is time for some heavy-duty arbitrariness. I decide to start with five copper rungs for strength and see if that is enough. If not, I'll put more in. I begin to write more and more notes to myself.

"Just build the thing, get it working, and test it," I can't stop thinking. So I spend Friday night with epoxy and wood, and big pieces of stainless steel to hold the wood together while the epoxy hardens.

11·6 Saturday morning and my L-beams come out really well. The epoxy has hardened and I would never have believed wood could be that stiff. I get into the shop expecting a mob at

PHOTOGRAPH ON PAGE 19: BRUCE JOHNSON



hours and make a catapult
and create the space program."

8 A.M., but fortunately there were a lot of good parties last night. I get on the Bridgeport to drill the holes for my copper rungs and I go for five rungs along two feet of ladder.

It takes all morning to drill the 40 holes and by the time I am through, the place is hopping. Everybody has their backpacks filled with wood strips and welding rod; for most students, this is the first day of construction. Some are building frames for their devices, some are making drive systems for their motors, and others are making wheels out of masonite on the lathes.

By 1 P.M., my beams and welding rod begin to look like a ladder and somebody says, "That's the best track I've seen yet."

"Thanks, but it's not a track, it's a ladder," I reply. The student says, "Oh well, it's nicely built, whatever it is."

By 2 P.M., I have interlaced string among the rungs of my ladder so that it extends fully when I pull in one end of the string. What a miracle—it works! But when I put some lead weight on the ladder and try to extend it, it promptly falls down.

I spend the next 30 minutes playing with my ladder in an attempt to resolve the problem. But nothing seems to work and I give up—for the time being. I spend the afternoon bike riding instead.

9:20 P.M.: In the middle of doing work for another course, I can't keep my eyes off the ladder. How the heck am I going to support that weight? The ladder looks great, but it won't work as is. There's got to be a way to support that weight.

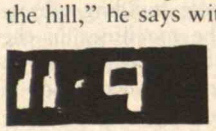
And then it comes—the proverbial lightbulb flashes over my head—and suddenly I know what to do. Why don't I shoot the ladder out with rubber bands? I can use the rubber bands to get my ladder extended and then use the string to winch some weight in a cart up the ladder.

12:40 A.M.: I am still tossing and turning in bed with different ideas on how to winch up the weight. The word "obsession" is beginning to take on new meaning to me, and that night I imagine a movie that stars Bette Davis and begins with "OBSESSION" in dripping letters across the screen. I realize that 2.70 has me.

"Now this is a good piece of engineering," Professor Bligh says as he examines my ladder. "But you've still got a lot to do and not a lot of time to do it in. Let's try shooting this ladder out with a constant-force spring."

He winds up the ladder and puts one section on top of another, with the spring fully stretched. "You stand over there and watch your eyes," he says. I am about five feet from him when he lets go of the spring and the upper section goes flying right into my arms.

"I think it's got enough pop to get up the hill," he says with a satisfied smile.



Tasks still to do: make copper legs that will catch the ladder if it tilts downward, cart to carry the gravel weight up the track, drive system for motor, frame for the ladder, details, details, details. It's enough to drive you crazy! Forget the electronics for now; that's only worth 500 grams. But I have to work on my other courses, keep my research advisor happy, keep up with my other problem sets. AARGH!

9 P.M.: I drop by my friend Ari's office. "Ari, this is becoming an obsession with me," I say. "I can't do anything else or think of anything else."

"Yes, it's like Co Ca Heen," he replies.

"Like what?" I ask, not for the first time mystified by my friend's accent.

"Co Ca Heen, you know, you breathe it in," and he takes a big breath through his nose. "And the more you breathe in, the more you want."

I stare at Ari for a minute and say, "Yes, that's it exactly." Then I go back to look at my machine.

Veteran's Day and am I going to the teach-in on nuclear war? "Noooooooo . . ." as John Belushi would have said; I'm working on my 2.70 project and on my 2.14 homework. I want to get ahead in my control systems course so I can concentrate on my firetruck. But all day I interrupt my other homework by running down to look at my machine.

4 P.M.: I am waiting for my falafel sandwich at a streetside vendor outside the main hall. The teach-in is over and a bearded man in his thirties walks down the steps toward Boston. He is wearing blue jeans, a leather coat, and has a wooden leg. I suddenly feel ashamed.

9 P.M.: "Do you realize what destruction there would be?" Ari asks, still fired-up hours after the teach-in. "It would set you back at least 100 years. There must not be a nuclear war."

I am a little disappointed, because I thought Ari, the staunchest anti-Soviet hawk I know, would reassure me that we need these weapons to keep the bear in his cage.

"And what's more," Ari continues, "there was nobody at the teach-in, no students, nobody. Don't you people care at all about this? It could be the end of the world and there'd be nobody there."

"But I have my problem set and my 2.70 project to worry about," I say. "I'll be there next year."

"Next year it will be something else," he replies.

People are coming into the shop with machine-like devices now. Fewer and fewer people are carrying backpacks with wood strips in them, and more and more are carrying boxes with partially completed devices. And I'm still at the backpack stage.

3 P.M.: Professor Bligh is out, so I speak with Professor Peter Griffith, another recitation instructor. "The point is," he says, "you could spend two hours on this project and make a catapult that gets a weight on the scale, or you could spend two years on it and then you'd have the space program. We're trying to teach you to make

ILLUSTRATIONS: MARK ULRIKSEN

"We're trying to make decisions based on limited time and resources. That's what the real world is like."

decisions based on limited time and resources. That's what the real world is like."

7 P.M.: I'm starting to freak out. I wonder how many nervous breakdowns this course has produced. I'm slipping on my personal schedule and goals. I've got to get that frame built, but it involves so many details I don't know what to do.

I talk to Ari. "Calm down," he says. "You've done good work so far. Just keep it up and don't let the pressure get to you."

"You're right. But tonight I'm so wound up I can't think. I've got to go skating."

There are about a hundred skaters at the indoor rink, and the ice gets chopped up only 15 minutes after the Zamboni machine cleans it off. The Zamboni looks more comprehensible to me now. I feel like taking it apart and seeing how every little piece works.

There are a lot of intense skaters out, starting and stopping fast. I tell my friend Luis that for M.I.T. students, skating is like grinding one's molars together. After 50 hard laps, I go home to get my good night's sleep for the week.

11·13 Raining. Thank goodness for that, or I'd probably blow the whole day bicycle riding to avoid working on my project. I go up to the room where the practice track has been moved to. There is one other guy in the room. He has a machine with big masonite wheels and wood hubs, and he's trying to get a grappling hook to catch the backboard behind the scale to winch his device up.

Today, I have to get this frame built. So I figure out heights of wooden pieces to cut, and I cut them. Then I make a list of tasks. The only way to keep your sanity in this kind of thing is to make lists and then check things off.

The student machine shop is open all day and there is no unemployment here. Every lathe, every bandsaw, every milling machine, every drill is in constant use. You might say the course is the Mechanical Engineering Department's answer to electric utility load management.

It's a war now. Innovations are researched, developed, manufactured, and tested in hours, even minutes. Only 120 hours left. No time to procrastinate, to put decisions off until tomorrow. This

class is the organic lab of engineering. Organic lab gives premeds operating room pressure; 2.70 gives engineering students production-line pressure.

9:30 P.M.: I am sitting in the men's room feeling the whole building vibrate from the whir of the machines in the basement. On one of my many trips up and down the stairs from the workshop in the basement to the testing ground on the fourth floor, I pause before the display case where the best machines from last year have been drawing the eyes of all the students and professors in the department. The best machines from this year will be there in January. My fatigue vanishes.

11:00 P.M.: An instant when all the machines are off. I miss the noise. Somebody then turns on the bandsaw.

11·14 Read funnies in library after lunch. Drill holes in ladder to catch it as it extends. Get the base glued together. So much to do. So many piddling details to attend to.

8:50 P.M.: I need familiar support so I call home. "I have some sad news for you, Pepper," my mother says. "Your dog just died." Oh geez, why does it all happen at once? Why didn't I wait to call until after the contest so I wouldn't have to worry about this? After I get off the phone, I kick a plastic cookie tray so hard it shatters.

Ari runs over to my office and finds me sobbing.

"You have to get back in control," he says. "The professors here don't care what happens to you, they just care about what you produce. Now go wash yourself and get back to work. You must finish the job you've started." He says it as if I am one of his soldiers who is shell-shocked. Firm, but I appreciate it.

12:30 A.M.: The base of my gadget is now epoxied together. I'm one day behind in my schedule, but at least I can go to sleep now.

11·15 I wake up realizing I'm just not going to have time to make the ladder stiff enough to hold the weight of a cart. So I decide to discard the cart idea and go back to my original idea of carrying the weight up at the end of the ladder.

I go to class in the morning, and in the afternoon, I decide to work on the electronics; I can use all the weight I can get. This is their way of bringing us mechanical engineers into the 1980s, I guess.

"How do I use this wire-wrap tool?" I ask an undergraduate.

"It's easy," she says as she uses the tool to wrap two wires around pins on my chip. "There, you try now." It is easy. Another mystery of technology has vaporized for me.

11·16 I've got the frame built, the electronics built, the ladder built. Now I just have to get the drive system built. So what if that's the hardest part? So what if I'm running out of money? I can't afford the nice cylindrical rods to build the two shafts in my drive system. The way I have figured it out, one shaft will be connected to my motor and turn a large wheel, which will then turn the other shaft, around which the string will be wound. I've already laced the string through the holes in the ladder, so when I start the motor, I hope the drive system will pull on the string, winching the ladder out into three fully extended sections. Since I'm running out of money,

I'll have to use a square bar that's cheaper and cut it into a round bar for the shafts. That should take only three hours. So not only am I inventor, researcher, production line worker and cost accountant; I'm also a microeconomist trading labor and time (my sleep) for capital (nice ready-made goods).

Four hours later, I have two rough-cut shafts. So now I get to start studying for my control-systems test. It's 9 P.M. and five hours of review should do it.

2:30 A.M.: Bedtime.

11·17

7 A.M.: Thirty-six hours left until the first trials begin. I have to get to the machine shop early so Aubrey Rigby can help me set everything up for my drive wheel. Aubrey is a master craftsman, a machinist who can cut a thousandth of an inch right down the middle. I had first met him when I had a bent shaft from an experiment I did as a research assistant. He took his hammer and his dial indicator, and with three taps it was running true.

9:55 A.M.: Go to pick up calculator and books for test in controls. I remember someone's comment that "going to M.I.T. is like getting a drink of water from a fire-hose."

11:05 A.M.: Test is long and I can't completely concentrate; I really hope the average is low. Back to machine shop.

12:10 P.M.: Machine shop closed.

1:20 P.M.: Thirty hours left to the preliminary trials. I can't blow everything because of a nonfunctioning drive system. It looks too good, my machine, not to have it in the finals. I've got to finish it.

I still have to:

1. Solder wires to motor leads
2. Turn down motor shaft
3. Make bearings for drive system
4. Build drive system

I'll need every hour that's left. I am so nervous I can't solder the wires so I cheat a little bit, and have the electronics technician in my lab do it for me.

8 P.M.: I jokingly ask Tony Purnell, the teaching assistant, "Are you going to keep the machine shop open all night?" I half want him to say no so I can get some sleep; half want him to say yes so I can fight to the wire.

"Yes," he says.

11 P.M.: Fifteen people in the machine shop, not to mention ten in Tiny's shop and ten upstairs testing at the track. Somebody brings in a radio to help keep us going through this gang all-nighter. People are singing along at the top of their lungs. You can just hear them over the whir of the lathes.

2 A.M.: Both shafts are finished. Now it's time to cut out the drive wheel and reduce its radius to make it fit in the bearing.

4 A.M.: The wheel is on the shaft. Now that I've made it to 4 A.M., I figure the back of the night is broken.

6:30 A.M.: The wheel works pretty well in the bearings. There is hope. Time to clean up so nobody will know that 40 of us were here all night. What would the insurance company say?

11·18

My digital alarm clock says 12:50 P.M. and my drafting test is at noon. AIEEE! I jump into my clothes and run across campus. At my lab, I can't read the clock. It looks like 11:30 but sort of like 12:30, and I can't tell the difference on three hours of sleep.

"Calm down," I say to myself. "Call the time."

"At the tone, the time will be 11:32 and 20 seconds . . . Beep."

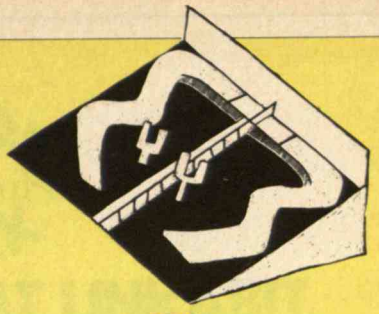
Whew! Thank goodness for defective clocks.

4 P.M.: Drive system works. Hope is growing.

5 P.M.: Testing on the track. The ladders don't extend the way they should. I go downstairs and put stops in. I keep threading the string wrong, and the sections jam against each other. But I'm hopeful—the string moves along the shaft in neat coils just like a real winch.

7 P.M.: Trials, round one. I'm up against Miss Hawaii (Pam Mitchell, who was Miss Hawaii two years ago). She has designed a truck that goes straight up the middle, but I'm too intent on my machine to notice how hers works. The power clicks on and my ladder goes out but as it extends it falls down under its own weight. I'm down but not yet out of the trial. I have to go downstairs to make some copper feet supports to catch it and keep it from falling.

8 P.M.: I'm standing in the machine shop, trying to figure out how to make these supports. I don't have the time. I'm sick of making all these stupid decisions. Where are the drill bits? How long do I make the rods? I have to leave the shop,



The Hands-On Approach

TEN years ago, "Introduction to Design" (2.70) was a conventional classroom course. Today, it is M.I.T.'s answer to the Super Bowl—a standing-room-only event that makes hundreds of spectators hoarse each year. The person who made 2.70 the most notorious course at M.I.T. is Woodie Flowers, a professor in the Mechanical Engineering Department.

"It grew out of our belief that you learn design by doing it," Flowers says. "The course is a microcosm of a real engineering design process."

Each fall, "Introduction to Design" gives students the chance to design something, build it, test it, and see it evaluated by "Mother Nature" in a one-on-one competition against other students.

"In the competition, Mother Nature applies all her rules all the time," Flowers says. "One of the most important lessons the students learn is that what they imagine must be realistic."

This year, Professor David Wilson took charge of the course while Flowers went on sabbatical. And Wilson, along with his students, learned that when it comes to design, the best-laid plans can go awry.

"When I designed the track, I thought the easiest way would be up the winding roads," Wilson says ruefully. "But it turned out that the easiest route was up the middle. Only two people [out of 160] made it up the winding road." — *Alison Bass*

"You have to be willing to forget about the time you spent going one way and turn around and go the other."

hit the wall and stand against it and try not to burst into tears. The stupid thing almost works. I can't quit now or all the time I've spent is wasted if I don't make it to the finals. Then . . . I say to myself, "Calm down. All you have to do is drill a couple of holes and put some welding rod in. That'll do for tonight."

I go back up to the course and, miracle upon miracle, it works! The ladder doesn't quite make it up to the scale, but it gets me into the arena of hope: a second trial.

11 P.M.: I am walking down to the shop and a stocky sophomore who I've seen in class is standing outside, looking forlorn.

"How's it going?" I ask in as graduate tutorial a fashion as I can.

"It doesn't work," and the student starts sobbing.

"Well, when is your trial?" I ask.

"Tomorrow," he sputters. "I've been up for the past three nights all night and it still doesn't work."

"I know what you're going through, believe me," I tell him. "If it's not possible to get the whole thing working, why don't you set some personal goals for the next few hours? Try, say, to get one or two subsystems to work."

"I've already gotten all I want out of this stupid course," he snarls and stalks away.

Wimp! I almost say it out loud.

11·19 Rest day, and time to catch up on other neglected details in my life, like paying bills.

11 P.M.: Finish ice skating. The plaque in the athletic center rings true: "Not the quarry but the chase; not the laurel but the race." Burgess, M.I.T. 1885.

12 A.M.: I have to get the ladder rungs spray-painted silver. It'll look good if nothing else.

11·20 Today is supposed to be my day for cycling because my device is supposed to be working. But Professor Bligh wants me to change it to a ladder with a hinge at the back and a wheel on the front like on a wheel barrow. The hinge should solve the problem of the ladder falling down, and the lead-lined wheel will supply my weight, even if it is only one ounce.

So that means: 1. Break the epoxy bonds on the beautiful base I built last weekend. 2. Build a wheel assembly for the ladder's front.

It's a lot of work but it's my only chance. I remember hearing Professor Ernesto Blanco say that he once spent seven years developing something, only to have it stolen by a foreign company.

"You have to be able to change," Blanco had said. "You put in so much work and you whine, 'But it will take so long to change . . . I did so much already . . . I don't want to change it.' But you have to be flexible, willing to forget about the time you spent going one way and turn around and go another way. Otherwise, you will not survive." It's insights like these that make the education at M.I.T. worth the money.

4 P.M.: I see a guy in the shop who's been working on something that is going to rise up and flip a track over and let a cart roll down the track onto the scale. It has a quality of construction second to none, even mine.

"Are you going to make it?" I ask.

"I hope so, but I'll be here almost all night tonight and tomorrow night. I guess we'll get to know each other pretty well. My name's Oscar, what's yours?"

"Pepper. It's a beautiful device," I tell him. "You really should sprint to get it to work. You've got 48 hours to the finals and then you can sleep." I am recruiting

people to stay up all night so it won't be as hard for me to.

9 P.M.: I have to figure out how to make this wheel, so I go upstairs to the course. The guy who pulled up eight pounds the Sunday before was there with his grappling hook, along with another undergrad.

"I think design is one of my strong points," he is saying.

Shut up you nurd, I say to myself.

"Yours didn't work in the first trial, did it?" he turns to me. "It looks good, but it doesn't work."

"It'll work," I announce, more determined than ever to see that it does. This kind of encounter is a good way to tell if you're "Type A."

1 A.M.: Sunday morning. I've got to get this wheel glued but I don't know how to make it. It's taking forever to decide how to cut just one piece of wood. Besides, all the drills are unmarked and all the rulers and micrometers have been swiped so I have to eyeball everything. Besides, I want to go to bed.

Fight it, I say to myself. Stay with it. Just make the thing work. Don't worry about how well. Just cut the pieces of wood and glue them together. Make the wheel on the belt sander. So what if it looks like something from the Flintstones; it's still better than nothing.

4 A.M.: The epoxy is setting in and the wheel looks good. Time for bed. The design has become me, and I have become the design.

11·21

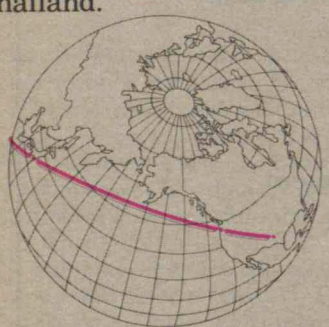
2 P.M.: Twenty-nine hours left before the contest. I see Oscar and he says, "Did you hear about what happened at Harvard yesterday? At the football game, right after one of the touchdowns, a small cannister sprung up out of the ground and then a balloon inside of it began inflating. The balloon was black, and it had M.I.T. written all over it. Finally it blew up and yellow smoke came out of it. It was in every newspaper in the country. It's got to be the prank of the century. Some of the people in 2.70 were in on it."

Score one for M.I.T.!

1:10 A.M.: Don't quit! I write it in my lab book to keep me going in the machine shop. Miss Hawaii and one other student have on their Sony Walkmans. I wonder

From the eaves of the most humble Thai dwellings, pots of radiant blossoms bid welcome. A custom as old as the culture itself, is the Thai's consuming passion for flowers. Their essence, delicate yet flourishing, colorful yet refined reflects the very personality of the people.

To revere, from childhood, the tiniest flower is to instinctively appreciate the subtle needs of the business traveler. The tranquility provided by your own separate cabin and generously proportioned seats. Your private bar, should serving yourself be your pleasure. Relevant periodicals and newspapers. Preferential entrées. Attentive, sensitive service. Peace and quiet. In a surrounding of vivid murals replicating ancient temple art. And orchids hand-picked in Thailand.



Royal Orchid Service, Business Class, takes a straight line from Dallas/Ft. Worth to Seattle, Tokyo, Bangkok. Shortening your flight by more than a thousand miles. (While enhancing your well-being.)

Thai

A Flight of Graciousness.

"So what if it looks like something from the Flintstones; it's still better than nothing."

how they can concentrate with those things on.

3 A.M.: I start testing. Ten other people are at the course testing their machines. My ladder springs up almost to the top; the Flintstone wheel works nicely, running smoothly up the astroturf. But the friction in the string is too much and my motor stalls.

5 A.M.: I try different combinations of springs and string, and I screw up the threading of the string for the winch twice. Mr. 8-lb. grappling hook comes in.

"I thought there'd be nobody here," he says.

"Admit it, you just came here to gloat," I reply.

6:30 A.M.: The second round of trials are proceeding, but my machine still doesn't work. I try it one last time, but I mess up the loading of the springs. After that effort fails, I have to hit something, and a box of computer cards is the closest thing. I vainly try to put them back in the box in order, and I tell myself to leave a note on the box sometime after the contest.

10:30 A.M.: The phone rings in the midst of my sleep. It is Professor Bligh. "Is your machine working?" he asks. "I have to make up the list for tonight, and if it doesn't work by 2 p.m. you won't be in the finals."

"Well, if you hadn't called it surely wouldn't have worked because I would have been asleep all day," I say.

I go to the track and 40 people are there. They're making last-minute adjustments, running back to the shop, making more last-minute adjustments and running back again. "Oh sh—, oh f—," can be heard about 20 times per minute.

I try to get the machine working one last time. It almost, almost gets to the scale but that's not good enough. I realize then that I'm not going to make it as one of the official competitors. Even so, Professor Blanco is impressed. Professor Bligh walks in and suddenly, I have an idea.

"How about letting me be one of the placebos?" I ask, referring to the informal contestants who can participate if someone doesn't turn up. "Let me have one more spring and my machine will work perfectly."

"That's a good idea," Professor Bligh says. "Let's go for it."

3 P.M.: One last trial with three springs and it's going to work. I'll be in the finals—if only as a placebo.

4 P.M.: I call the Lafayette Square firehouse and talk with the fire chief. I tell him I talked with a lieutenant with an Irish name about borrowing a helmet and raincoat for a contest at M.I.T. "Who might that be?" I ask the fire chief.

"We're all Irishmen," he replies. "But come on up to the firehouse and we'll see what we can do for you."

6:45 P.M.: The 600-seat lecture hall, where the contest is being held, is already full. But I manage to find a seat on the aisle. I'm holding my machine like a mother holds her baby. There are a lot of paper airplanes being thrown.

7 P.M.: Professor Wilson quiets the crowd. "Before we start," he says, "I would like to squelch an ugly rumor that has been circulating. There will not, I repeat, there will not be a large crimson balloon inflating on our stage tonight." A delighted roar erupts from the crowd. Wilson continues: "We'll be going one-on-one for as many rounds as it takes to get a winner. The first round will have 40 contests, the second will have 20, etc."

The first round begins. There are lots of little trucks going underneath the cacti, but most only make it halfway up. Massive sighs erupt from the crowd when one truck almost makes it to the scale. Then comes the contest between a miniature motor-driven football player and another little dump truck.

"Punt, punt, punt," the audience shouts.

And boom the little football man kicks a film canister right through the arms of the cactus. He makes a field goal within seconds; his opponent's truck stalls halfway up the astroturf.

Eight contests later there is a no-show. I walk up to the stage with my red and silver "firetruck" and my firefighter's helmet and raincoat. "We need the placebo," Professor Wilson says.

"Pla-cee-boh, pla-cee-boh, pla-cee-boh," the crowd chants.

I walk up to the starting ramp. I put my device down. I hook up the power wire. Professor Wilson flips the power on.

"Thawockkk!" My spring-loaded-Flintstone-wheel-fire-engine-ladder shoots out and puts an ounce of weight on the scale in half a second. My opponent's miniature dump truck loaded with gravel stalls halfway up.

I look at Professor Wilson. He looks at me. "That was great, Pepper," he says.

Editor's note:
The author participated in six more rounds as an unofficial contestant and his ladder tipped the scale all six times. But the winner of the 1982 design contest was George V. Anastas, Jr., '84, who built a "dump" truck that steered itself under the cactus and delivered seven pounds of gravel to the top in 19 seconds. Anastas received a trophy for his efforts and the chance to have his design on display in the exhibit case.

PEPPER WHITE is a graduate student in M.I.T.'s Department of Mechanical Engineering. His current obsession is passing the Ph.D. qualifying exams.

while I flew MIGs and Phantoms on a neighboring terminal. I wanted my kids to feel that gut-level thrill we hackers get whenever we get near a keyboard. I wanted them to lust after the primo tool of our era as L.A. teens crave souped-up 1957 Chevies.

Still, every rose has its thorns, and every computer program its bugs. Even an enthusiast has to admit there are hazards to computer games, although they have escaped the scrutiny of most alarmists so far. What perils do I see awaiting those lured down the silicon path?

☐ Malnutrition. By age 13, my daughter Gale was skipping lunch to spend her food money on video games. Understand this was at a time when she had unlimited free access at home to a TRS-80 Model 3 equipped with Asteroids and Scarf-Man (a Pac-Man clone). I countered by paying for school lunches with checks. Now she brings her high-school buddies home for lunch, not to eat but to zap Zylons on our Atari 800.

☐ Social Backwardness. How's a teen supposed to learn social adeptness while hunched over a joystick? True, Gale has begun dating. But, honestly, making out while blasting spiders in a game of Centipede? Am I ever going to make it to grandmotherhood?

☐ Poverty. You think you'll stop the hemmorrhage of quarters by laying out a one-time $1,500 or so for a home computer system? "Mom, they have *Ms.* Pac-Man for the Atari 800 now!" announces 13-year-old Windy. I promise her I'll buy it as soon as the next check comes in the mail. I pick up this week's *InfoWorld* to regale myself with in-depth analyses of the latest generation of databases. "New games for VIC 20, Atari, IBM PC, and Apple," scream the headlines. "Pollution-fighting robots, paratroopers, and an excavated temple . . ." Who am I kidding?

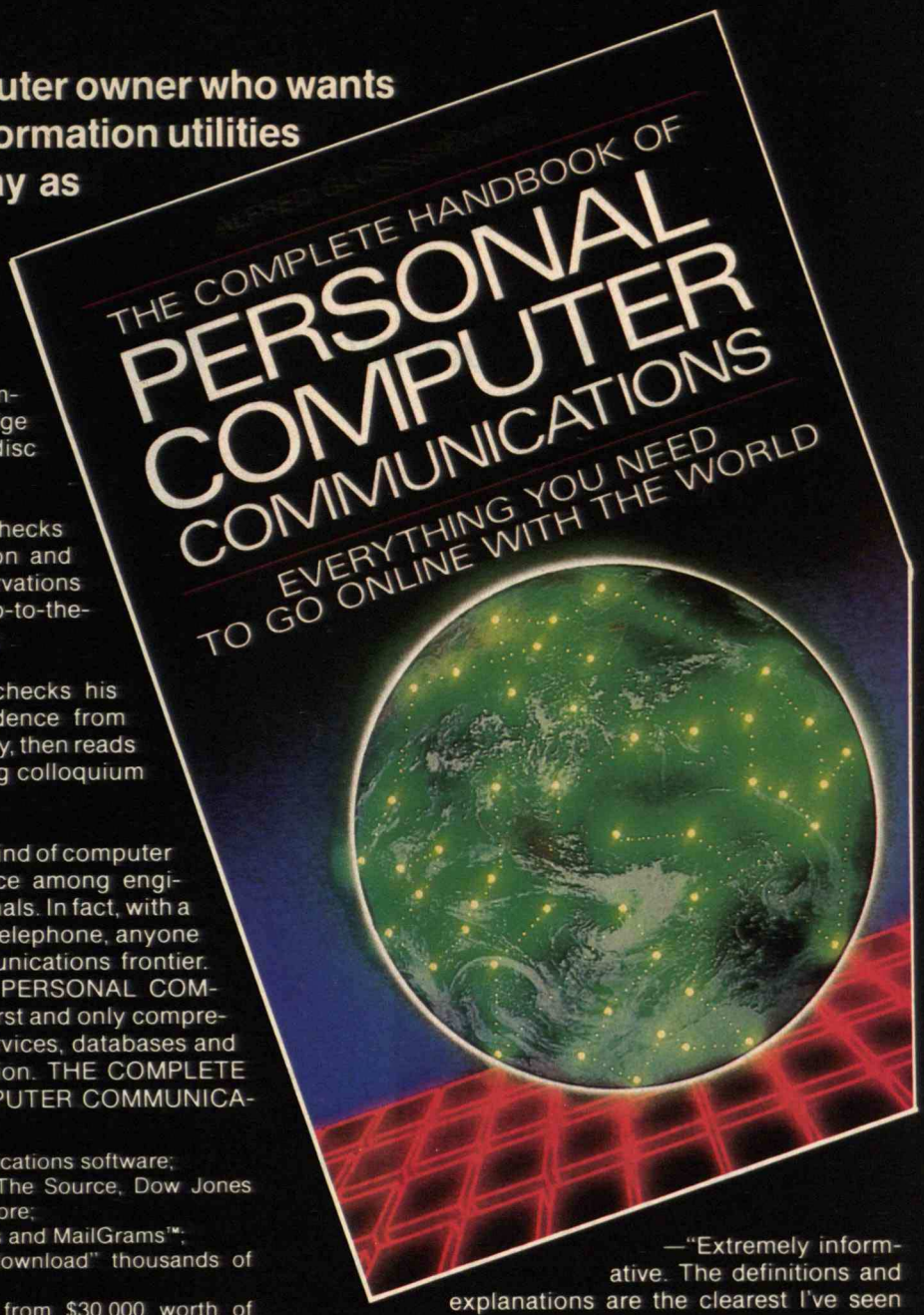
But other than causing collapsed health, personality disorders, and bankruptcy, the computer has been a boon to the family. I beam smugly when the neighborhood toddlers come over and my three-year-old Ginny runs to the computer and loads a game of Breakout for them to play. Valerie, nearly five now, uses the screen editor to work on spelling, although her more typical achievement is to clear the maze at Pac-Man.

In any case, regardless of whether computerized amusements are good or bad for young or old, they're here to stay. According to *InfoWorld* columnist Bill Freda, "The motto of the 1980s is Pac-Man or perish." Why fight the inevitable? When *Technology Review* pays me for this column, I'm going to buy a disc drive for the Atari. ☐

CAROLYN MEINEL, a systems engineer, is a long-time computer-game hacker.

"Essential to any computer owner who wants to plug into the vast information utilities that lie only as far away as the telephone."

—Forbes



*A consulting engineer orders a computer search of recent articles on bridge construction, then stores the data on disc for future use;

*An executive on a business trip checks weather conditions at her destination and last night's sports scores, makes reservations for her return flight, and obtains up-to-the-minute quotes on her stock portfolio;

*A pilot whose hobby is avionics checks his "electronic mailbox" for correspondence from other avionics buffs around the country, then reads the latest contributions to an ongoing colloquium on proposed FAA regulations.

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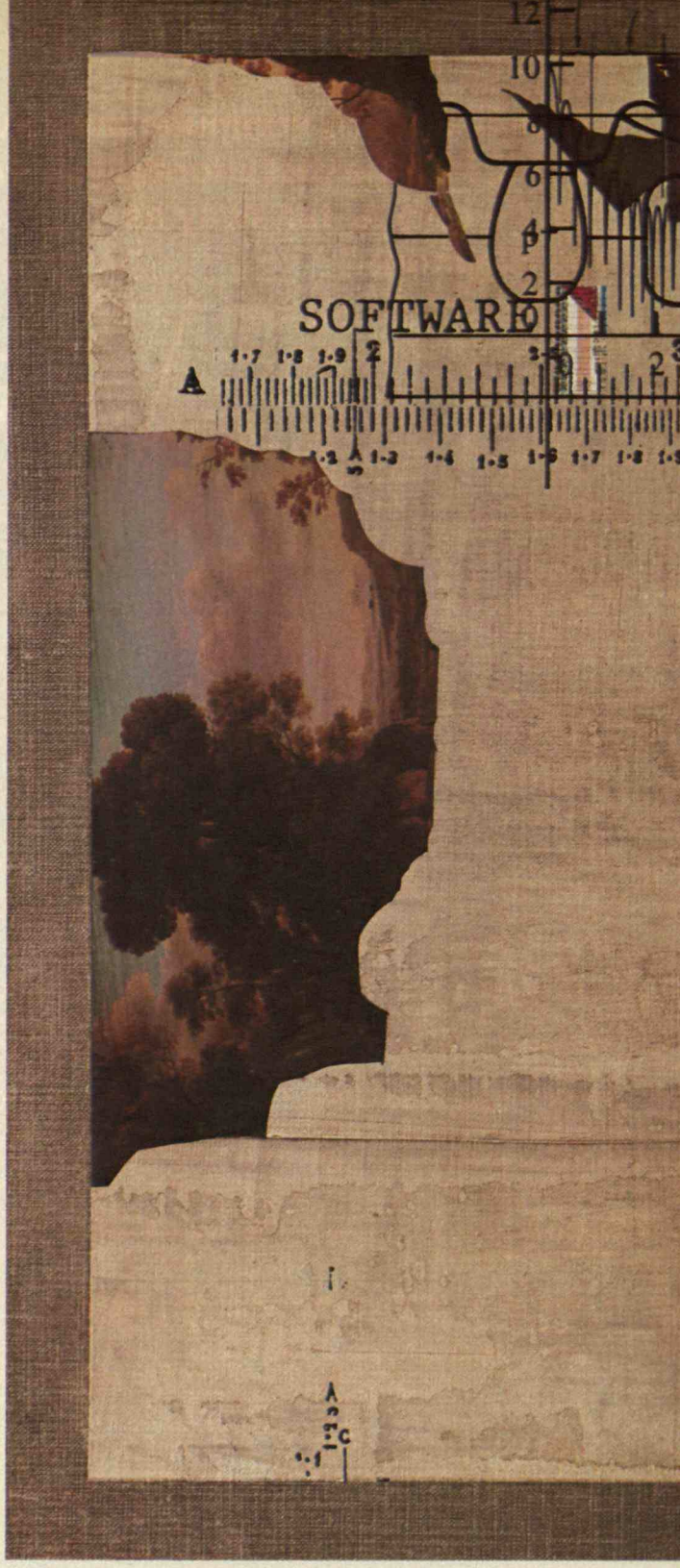

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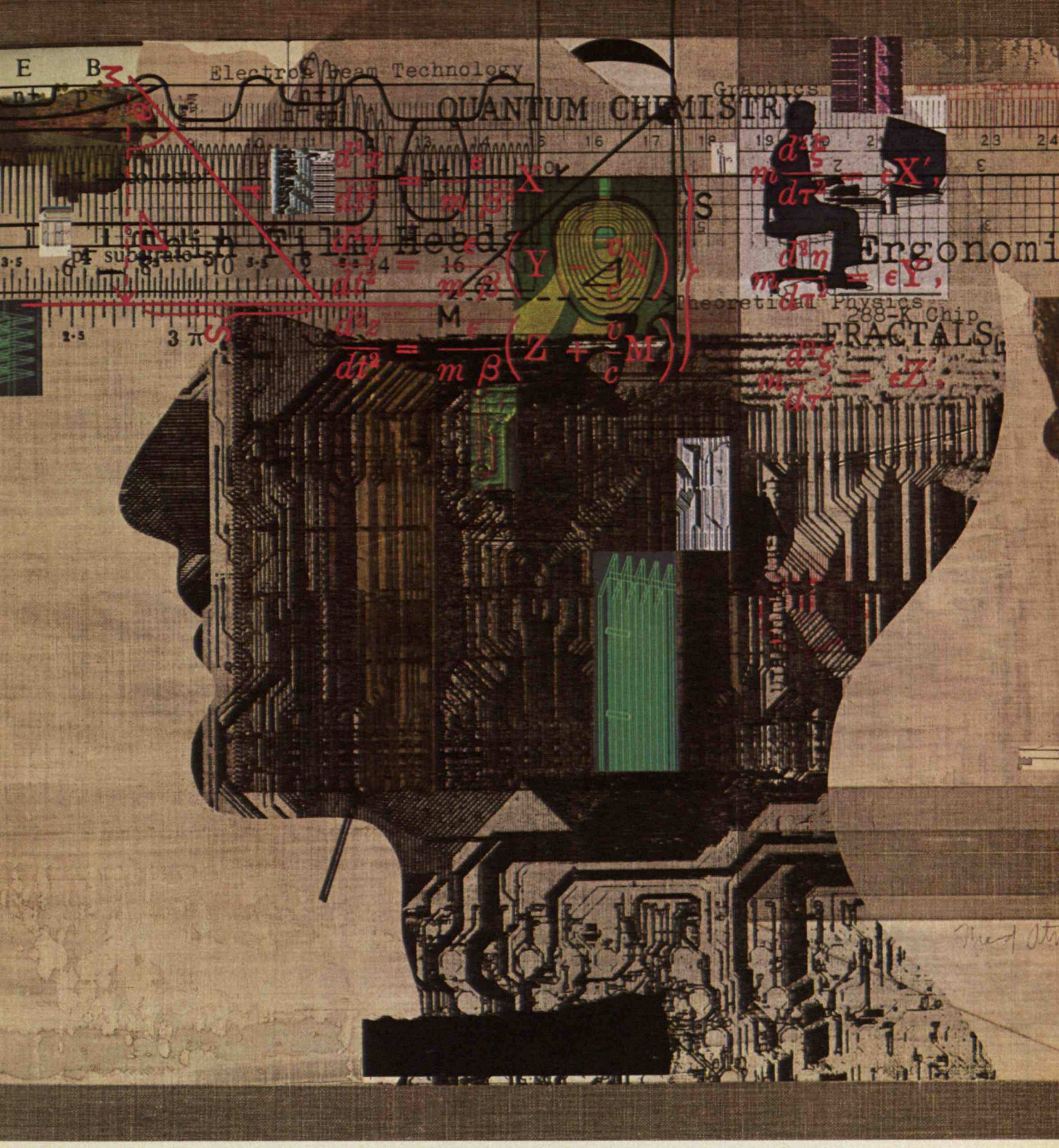

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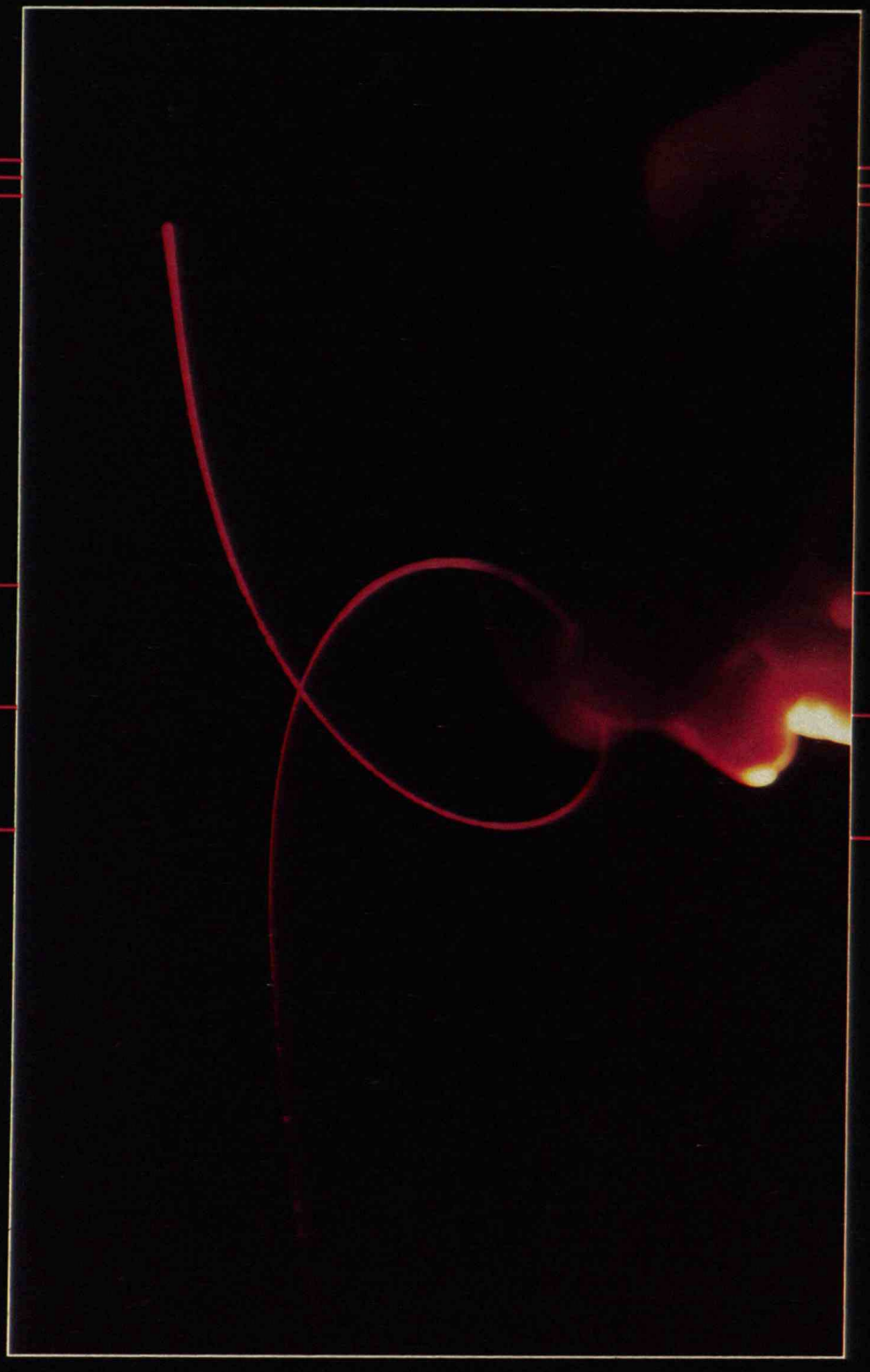


A single photograph captures the technology of optical fibers that is creating a revolution in transmitting information. Laser light shooting through a hair-thin glass strand has vastly more communications capacity than today's electronic-based wire and radio channels—a prodigious new resource.

PHOTO: WOODFIN CAMP & ASSOCIATES, © HOWARD SOCHUREK

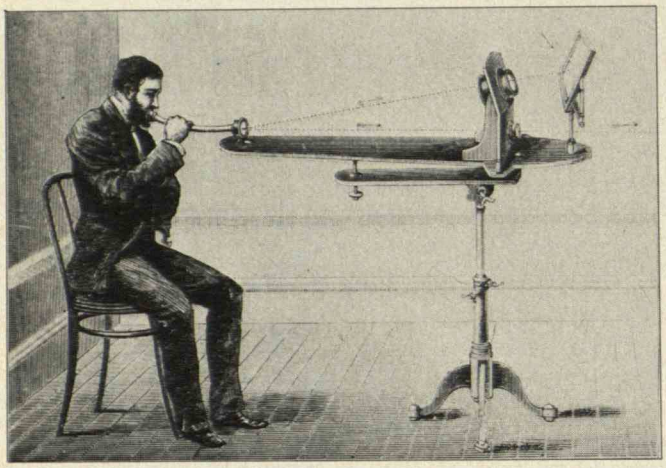
Optical Fibers: Where Light Outperforms Electrons

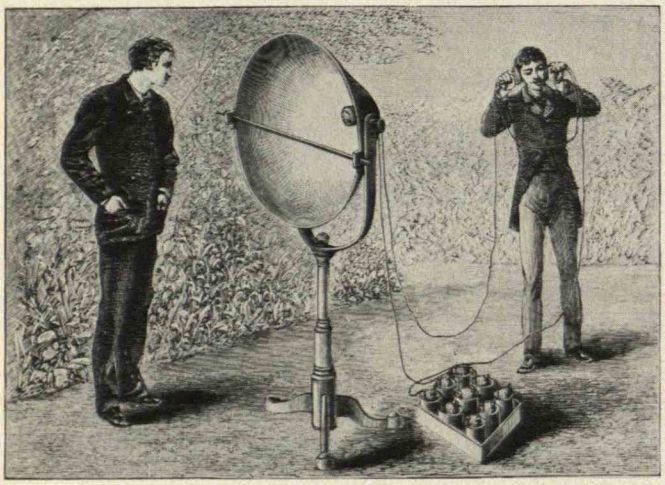
BY LES C. GUNDERSON AND DONALD B. KECK

We are only beginnning to tap the prodigious capacity of a laser to generate optical signals, and of a tiny thread of purest glass to deliver them over remarkable distances with unprecedented fidelity.

A revolution has begun in the technology of transmitting information. The rebel force is optical fiber—a thread of purest glass five-thousandths of an inch in diameter, about the size of a human hair—through which laser light of high purity and intensity can be transmitted. This radical departure from traditional electrical and electronic communications is destined to increase by a factor of hundreds our capacity to move words, pictures, and data from place to place. Today's crowded communications cableways can be relieved, complex databanks can become more easily accessible to anyone with a personal computer, and vast amounts of information can be exchanged at very modest costs.

Already over 100 communication links using optical fibers have been installed in North America. The first segment of the





Alexander Graham Bell's photophone, patented in 1880, was the first attempt to use light to transmit sound. Sunlight, bounced off a reflector and focused by a lens (above), was intermittently interrupted by a mechanism that vibrated in reponse to sound waves. At the receiving end (below), the intensity of the light determined the resistance of a selenium cell and thus controlled an electrical current. A telephone receiver then recreated the original sound waves from the variations in this current.

largest commercial optical system in the United States went into service early this year between New York and Washington. Soon this will be part of a 1077-kilometer optical-fiber network connecting 19 local telephone switching systems from Boston to Richmond. The cable used in this system contains 100 glass fibers, each of which can carry up to 240,000 telephone calls (or lesser numbers of video or data transmissions) simultaneously. The half-inch-diameter cable has as much capacity as a two-and-a-quarter-inch cable of copper wires.

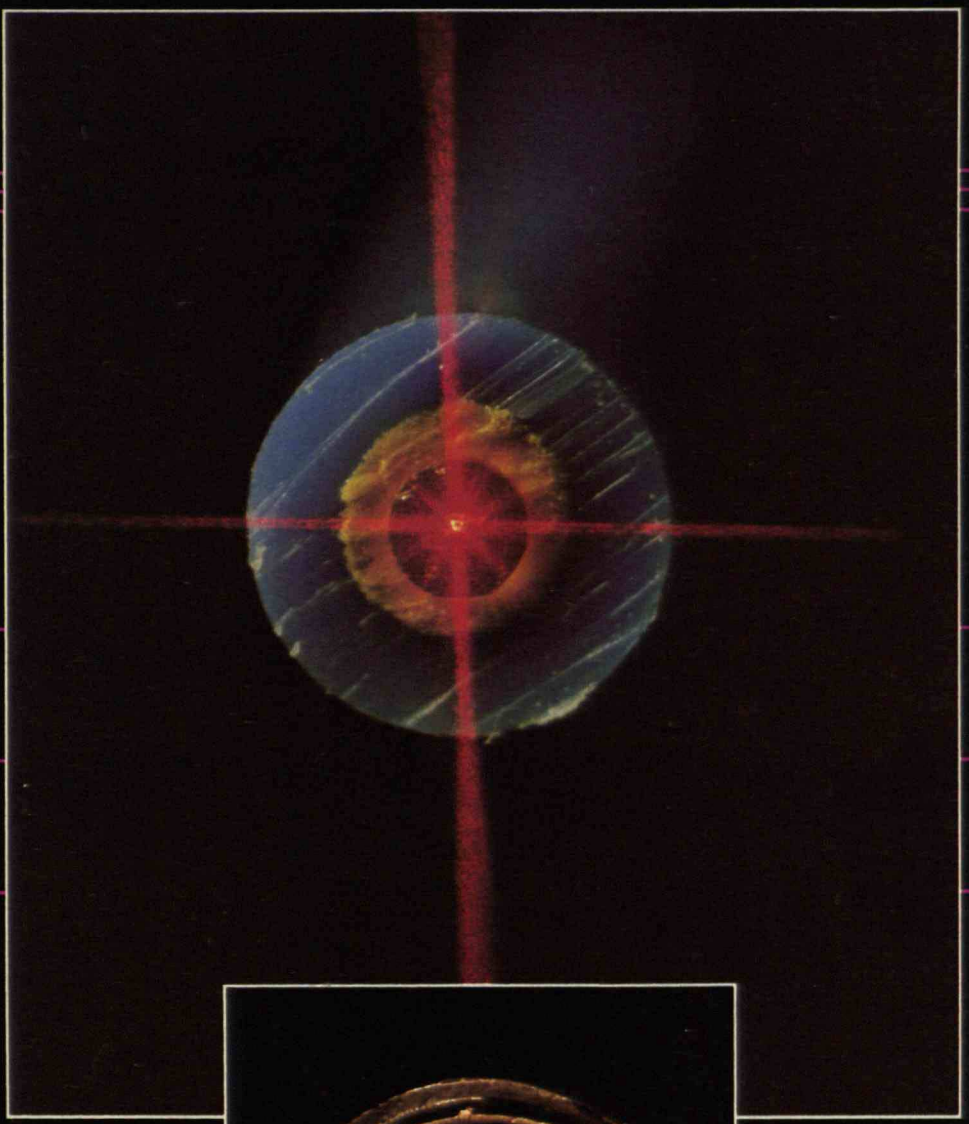
Its high capacity and efficiency make optical fiber one of the most cost-effective conduits available. The small size of typical optical fibers is also a significant advantage. Another is that "signal tapping"—that is, unauthorized eavesdropping—is extremely difficult. And optical-fiber communications are free of electromagnetic interference.

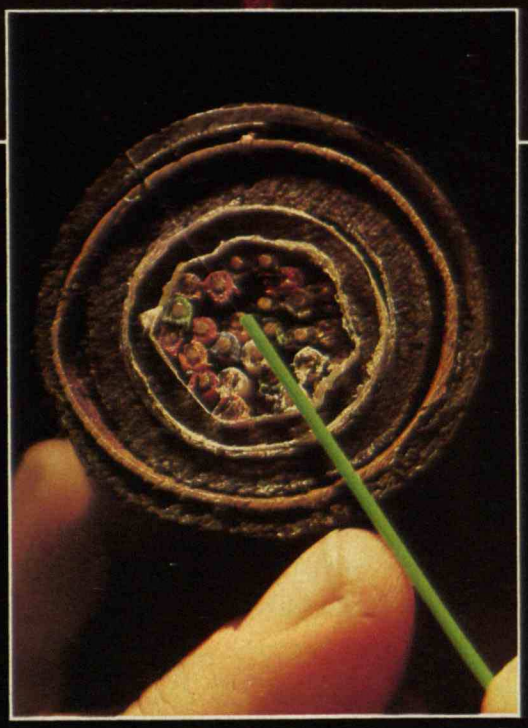
The Seeds of Revolution

The first suggestion for using light to transmit sound was made about 100 years ago by Alexander Graham Bell, inventor of the telephone. Bell was intrigued with the light sensitivity of the metal selenium—its electrical resistance varies directly with the amount of illumination—and he patented a "photophone" that exploited this phenomenon in 1880. But Bell's vision was premature; 70 years later scientists were still seeking more intense light sources and better transmission media to achieve their goal of practical optical communications.

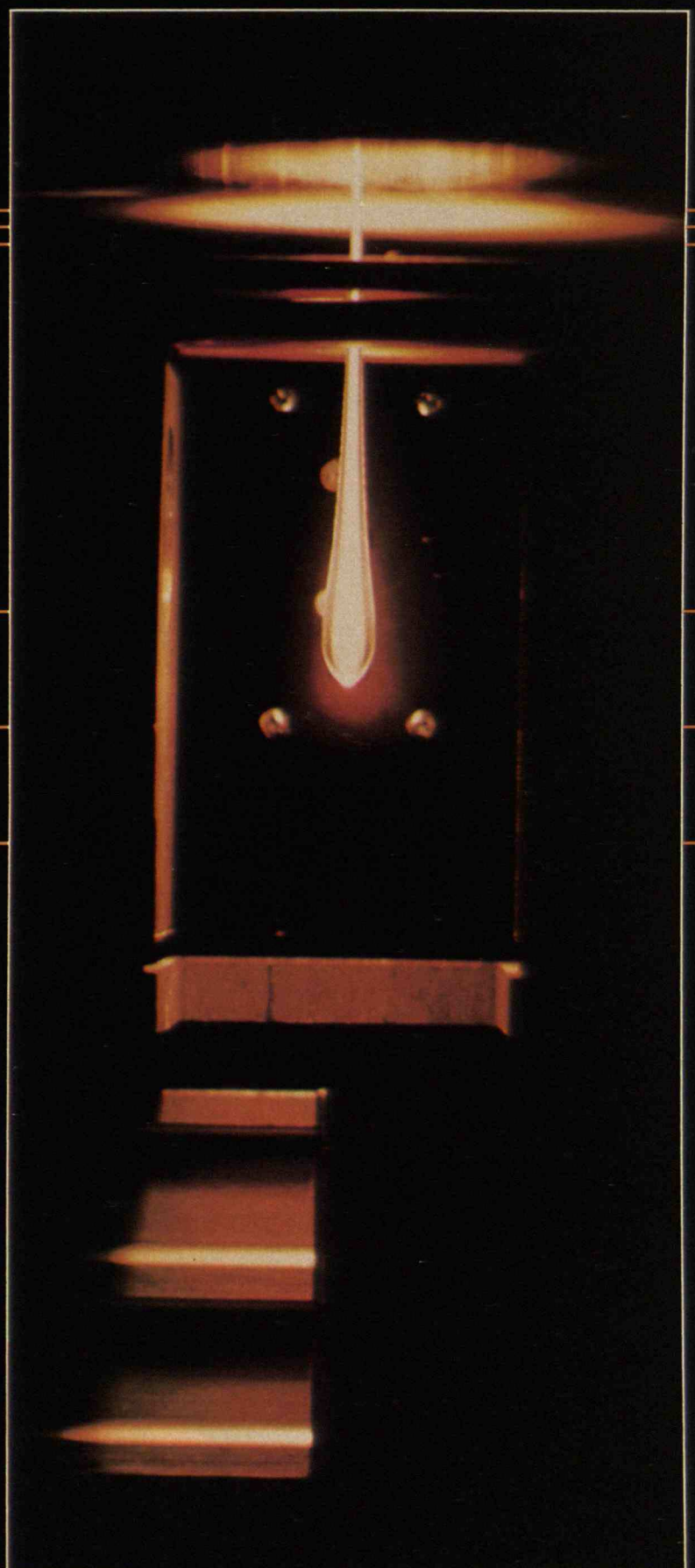
When the laser was first conceived in the early 1960s, its potential as an effective source of the intense light required for optical communications was obvious. The scientific literature was quickly flooded with reports of methods for modulating and detecting laser light. These first lasers generated light in the visible part of the spectrum, which is affected by the same factors that impair long-distance vision—atmospheric particulates such as fog, smoke, rain, and snow. Therefore, engineers proposed to transmit the light in pipes with controlled atmospheres. But the pipes, lenses, and mirrors had to be precisely aligned, and experimenters soon discovered that instead of building transmission conduits, they had constructed some of the world's most sensitive seismometers.

In 1966, scientists at Standard Telecommunications Laboratories postulated that glass of extreme purity could be used to transmit the laser light. About four years later, scientists at Corning Glass Works demonstrated that a fiber of high-silica glass could transmit 1 percent of the light energy introduced at one end over a distance of one kilometer. This efficiency, although not high, was 98 orders of magnitude better than that of others fibers at that time, and was in fact considered the threshold for practical systems. If the American Revolution began with a shot heard around the world, this was the light seen round the world.





Above: Laser light emerges from the end of a severed cable. The speckle pattern in the red indicates that the laser light lost its coherence as it moved through the cable along multiple paths, reducing its information-carrying capacity. The diameter of this cable, including several protective polymer coatings, is 3 millimeters; the diameter of the actual fiber, not visible, is only 1/8 millimeter. Yet even this relatively primitive fiber is capable of carrying thousands of telephone conversations simultaneously. This remarkable capacity is dramatized at left: the single fiber handles the same volume of communications as the many conductors in the much larger conventional cable.



Efficient optical communications require glass of extreme purity fabricated into fibers of consistent size and density. The required high purity is achieved by "vapor deposition" (above), in which the glass ingredients are vaporized, reacted together with heat, and condensed into pure glass. Fiber is drawn from this glass "preform" much as taffy is drawn from a bowl. The photo at the right shows the beginning of a "multimode" fiber draw, when it is possible to see the high-density core and lower-density cladding glasses.

Through a Glass Lightly

Two distinct causes of loss of light potentially limit transmission through glass: absorption and scattering.

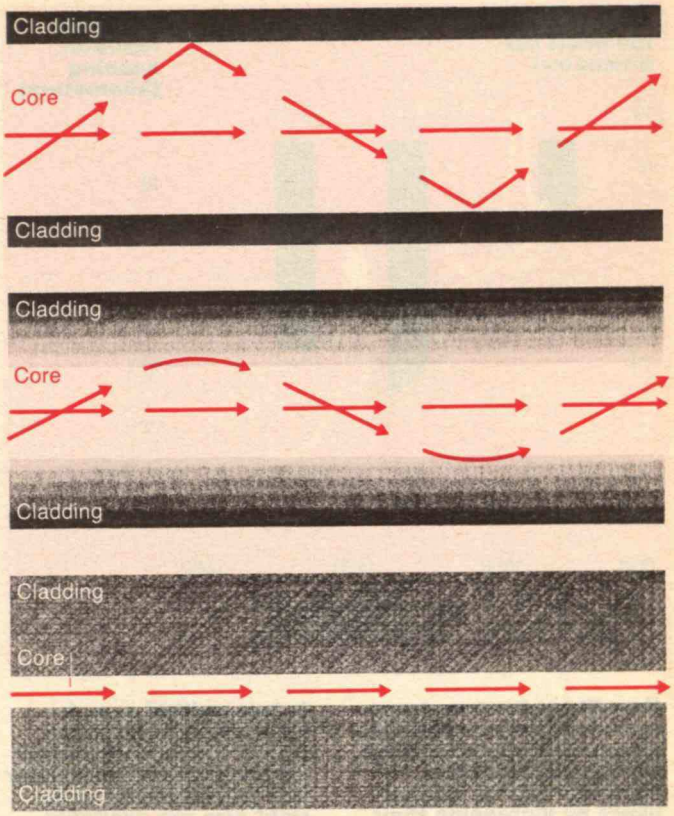
The principal cause of absorption is impurities—the ions of iron, copper, cobalt, vanadium, and chromium that have long been troublesome contaminants in high-quality optical glasses. For optical fibers, even one to two parts per billion of such metallic impurities are unacceptable; this is 0.1 to 1 percent of the amounts acceptable for most optical applications. Picture a hallway stretching five and a half times around the earth at the equator, floored with standard nine-inch-square white tile. A single row of red tile stretching across the hallway somewhere along its length would represent an impurity sufficient to absorb an intolerable amount of laser light in an optical fiber. Thus, a process that makes possible extreme purity—called "vapor deposition"—has been the key to the advancement of optical-fiber communications.

Scattering, the other source of light loss, is a change in the light wave caused by a change in the density of the transmitting medium. Small irregularities that can cause scattering are very common in glass—the result of temperature variations in the mix as the glass solidifies. These irregularities can be largely although not completely controlled in manufacturing, so present fibers are able to conduct light for remarkably long distances. Indeed, if the oceans were as transparent as today's low-loss optical fibers, one could see the bottom of the Mariana Trench from the surface of the Pacific Ocean—32,177 feet down.

Scattering losses are inversely related to the fourth power of the wavelength of the light. This means that long-wave red and near-infrared light is more easily transmitted through fibers than blue and near-ultraviolet light. Thus, a "window" of wavelengths in the near-infrared, between 600 and 1,600 nanometers, is now being used for communicating through optical fibers. (Most people cannot see light of wavelengths longer than about 700 nanometers; nanometer is one-billionth of a meter.)

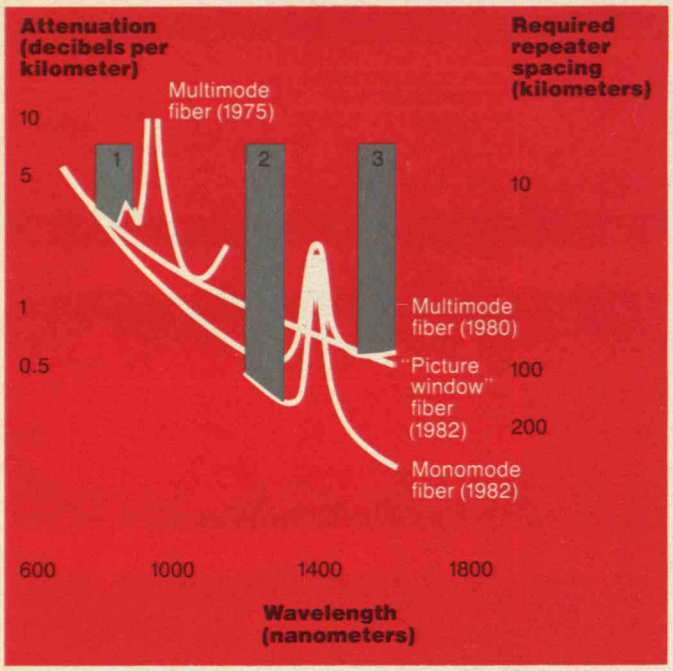
Optical Fiber: Reflecting upon Itself

The simplest form of optical fiber, known as "step-index" fiber, is based on the principle of "total internal reflection": when a beam of light strikes the boundary between two materials of different densities at a suitably low angle, the light is fully reflected back into the denser material. This is why, for example, a person swimming underwater cannot observe objects above the surface except within a 44-degree cone of the vertical. The surface of the water outside this cone has a silvery appearance. Optical step-index fiber is constructed with a core region of dense glass surrounded by slightly less dense material. Light striking the cladding (the outside layer of glass) as it moves through the fiber is reflected back into the core. Thus, light zigzags through the fiber by reflecting first off one side and then another of the core-cladding interface.



The three fibers of fiber optics. "Step-index" fiber (top) consists of glasses of two different densities, called core and cladding. Light zigzags down the core, bouncing off one side and then the other of the core-cladding interface. In "graded-index" fiber (center), the glass in the core varies in density, so the light travels in a smooth, curving path. Thus, its information content is less distorted. In "monomode fibers" (bottom), the core is very small in relation to the wavelength of the transmitted light. The light therefore moves down the fiber in a straight line with very low distortion.

PHOTOS: BELL LABS; VALTEC



How fibers become transparent. For over a decade, glass chemists have been seeking to decrease losses of light in optical fibers by increasing their purity. The goal is to find combinations of light and glass for which 80 percent of the light entering a fiber is transmitted over 1 kilometer. Three "windows" have been chosen where fiber losses are low and light sources of the right size are available. Under these conditions, repeater stations are required at 50-kilometer intervals.

This simplest optical fiber suffers from one major drawback: the transit time of a beam following the longest possible zigzag path is far greater than that of a beam traveling straight through a fiber. This means that over a one-kilometer distance, the sharpness of the signal, which consists of a series of on-off pulses, is significantly reduced, severely limiting the system's information-carrying capacity. Indeed, step-index fiber is unable to carry more than one television channel for one kilometer—hardly the type of performance from which revolutions are made.

This problem has been solved by developing two other forms of optical fibers. In "graded-index" fiber, the glass in the core varies continuously in density—high at the core to low at the core-clad interface. As a result, instead of zigzagging abruptly, the light rays travel in smooth, curving paths, being turned gradually back toward the center as they encounter the decreasingly dense glass near the cladding. Though these curving beams travel nearly the same distance as in step-index fiber, a larger portion of their travel is in the low-density region of the fiber. where they travel faster. Their transit time is therefore more nearly that of rays that propagate straight along the axis of the fiber.

The other solution is to reduce the diameter of the fiber core to approximately the wavelength of the transmitted light—two to eight micrometers. In such "monomode" fiber, all light waves take a straight path, reaching their destination essentially simultaneously. Thus, monomode fiber has much increased information-carrying capacity—sufficent to carry 40,000 conventional television channels over a one-kilometer distance. Although this far exceeds the capacity of any present electrical cable, it is still about 1,000 times less than the theoretical carrying capacity of a light wave.

This theoretical capacity is determined in the following way. Information is typically transmitted through an optical fiber in digital form—that is, as pulses of light, much like those that might be used to transmit Morse code. The maximum frequency of such pulses through an optical fiber is set by the ratio of the speed of light to the wavelength of the light being transmitted, which works out to be about 300,000 trillion pulses per second. But so far it has not been possible to switch lasers on and off this fast. Indeed, the best lasers pulse only about 10,000 million times per second under laboratory conditions.

It's Not Like Glassblowing

Making fibers generally involves at least two distinct steps: preparing a high-purity glassy "preform" and forming fiber from it. Making glass in the conventional way—melting its ingredients together—is unsatisfactory; the heating process permits the entry of too many contaminants. Instead, glass for optical fibers is made by the "vapor-deposition" process, invented by Corning.

High-purity vapors of silicon and germanium are reacted by applying heat to produce layers of glass. The composition of this glass can be altered by changing the proportions of these ingredients to produce the different densities required for graded-index fibers. One approach is to react the silicon and germanium within a flame, depositing the reaction products onto the outside of a rotating mandrel. Another approach is to react the materials inside a glass tube. The preform produced by either the "outside" or

DIAGRAM: OMNIGRAPHICS

"inside" vapor-phase deposition technique must later be heated and pulled into fiber. The Japanese are varying the outside process by depositing the reaction products on the end of a rotating mandrel.

People usually associate glass with breakage, but the strength of pristine glass is actually greater than that of a similar piece of steel. However, if the glass surface is flawed even microscopically, the glass fractures easily. Thus, to retain their high intrinsic strength, optical fibers are immediately coated after manufacture with various polymers to protect against abrasion.

When still greater strength is required—as, for example, when fibers are to be pulled through ducts in underground communications systems or subjected to crushing forces—the coated fibers can be gathered into cables. Indeed, 50 formed into a bundle two millimeters in diameter could easily support a 200-pound person. Plastic-coated cables containing several tens of fibers are routinely fabricated just as in the conventional electrical cable industry.

New Wavelengths, New Switches

In 1970, just as Corning demonstrated the first graded-index fibers, the first gallium-arsenide lasers were emerging to provide a source of light far more satisfactory than the gas lasers first considered for optical communications. However, these new lasers still created light beams that were large compared with the optical fiber cores. But by the mid-1970s, the technologies of fibers and beams converged, and optical-fiber communication reached its first plateau—lasers emitting at wavelengths of 800 to 900 nanometers projecting into graded-index fibers. These "first-window" systems were economically competitive with electrical coaxial systems for many uses requiring intermediate resolution (or bandwidth). These systems could transmit light through ten kilometers of fiber, and repeaters (or amplifiers) placed at 10-kilometer intervals made long-distance transmission possible.

At this point the parallel evolution of fibers and lasers accelerated. Fibers were found to be more efficient—with lower losses and greater bandwidth —transmitting frequencies of 1,300 nanometers. And adding indium and phosphorus to the basic gallium-arsenide lasers made them operate in the 1,100-to-1,600-nanometer region. This led to high-performance "second-window" systems operating at

Fiber-Optic Communications: Where Will They Lead?

COMMUNICATION systems that send light waves through fiber-optic cables are in use in more than 20 countries, ranging from Indonesia, which just laid its first 8.7-kilometer cable, to Great Britain, which has over 4,000 kilometers of fiber in operation. These optical-fiber systems were chosen because they were more economical than the alternatives—copper wire, radio relay, and satellite. Since fiber optics is still an immature technology, scientific advances coupled with increased experience in manufacturing and operation suggest an even more promising future.

The economics of optical fibers are so favorable that Anthony Rutkowski, staff advisor to the chief scientist at the Federal Communications Commission, predicts that all telephone exchanges in the United States will be interconnected by optical fibers by the mid-1990s.

Consider the optical-fiber cable that AT&T is currently installing between Boston and Richmond, Va., to accommodate the steadily growing demand for telephone service. (Although demand for computer-data transmission over telephone lines is also growing rapidly, it still represents only a small percentage of total demand, according to AT&T.) Since optical fibers carry much more information than copper wires of the same diameter, AT&T will provide the additional capacity by drawing optical cables through existing conduits. By using optical fibers instead of copper wire, AT&T expects to save over $49 million in construction costs alone.

Optical fibers have another advantage. After a certain distance, signals sent on both copper and optical-fiber cable lose clarity and must be regenerated. But repeaters to regenerate the signal on copper cables are generally spaced every two kilometers, while the distance between repeaters on fiber-optic links is four times as long. This means significant savings in both installation and maintenance.

Indeed, it sometimes costs more to maintain copper cables than to rip them up and replace them with optical-fiber cables, according to AT&T. As better fibers and optical transmitters are de-

Continued on next page

Fiber-Optic Communications

Continued

veloped, the distance between repeaters—and the relative economy of fiber-optic systems—will increase enormously. Already scientists at the British Telecom Research Laboratories have reported sending 140 megabits per second (equivalent to 1,920 telephone channels) without regeneration over a 102-kilometer length of cable.

The majority of communication links over 30 kilometers in length are now handled by microwaves relayed from one transmitter to the next, and fiber optics are challenging this technology, too. Microwave relay service is difficult to expand in densely populated areas, where few, if any, frequency bands remain unoccupied, according to AT&T. There are no such limits on optical-fiber transmission, which will soon be as cheap as radio relay, says Malcolm Ross, a consultant at Arthur D. Little International.

The longest communication links are handled by satellites. The cost of satellite transmission, unlike that of terrestrial systems, is relatively independent of the length of the link. Such communication is especially effective between sparsely populated areas that cannot easily be connected by a telephone cable. But even here optical fibers have a role since they can carry large volumes of information more efficiently. An optical-fiber cable would be more economical for links thousands of kilometers long if it carried more than a thousand phone circuits, according to Sir George Jefferson, chairman of British Telecom. In some cases this crossover point is already in sight. AT&T proposes to use optical fibers for the next trans-Atlantic cable, as well as for a link between the continental United States and Hawaii. Both cables are expected to be in operation by the end of the decade.

Indeed, the only place where fiber optics have few advantages is on local exchanges. The lowest-capacity optical fibers ever installed for commercial telephone use by AT&T carried 672 phone circuits per fiber pair, and many local routes require but a small fraction of this capacity. Nor is repeater spacing a factor on very short routes. So Rutkowski predicts that local service will continue on copper wire until the amount of information to be carried into homes increases dramatically. —*Janet Yanowitz*

1,300 nanometers, with repeaters spaced at intervals of 15 to 30 kilometers.

At this point, engineers installing first-window systems were in a quandary. The success of second-window systems assured that first-window systems would eventually be obsolete. Yet extending existing systems operating in the first window was obviously less expensive than standardizing the new second window. The dilemma was resolved when fiber manufacturers, particularly Corning, were able to design a new fiber material that operated at a wavelength between the first and second windows. These "double-window" fibers gave satisfactory performance at both wavelengths, so that first-window systems could be implemented immediately, with transmitters and receivers in the second window installed as they became available.

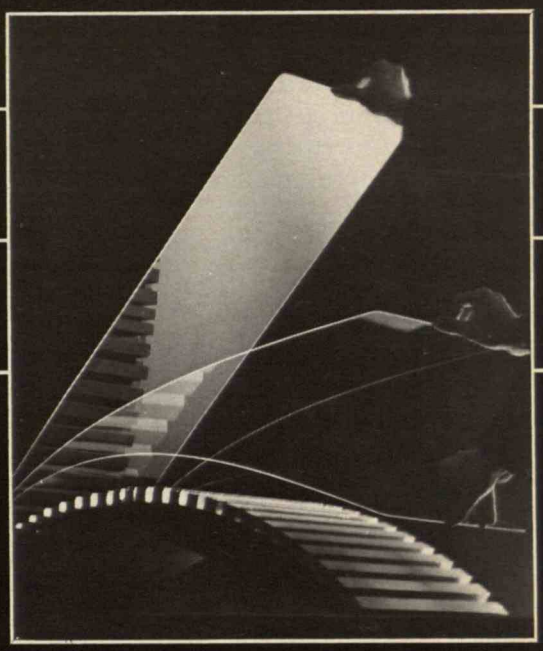
But events did not stop there. The latest fibers are most efficient transmitters of light at still higher wavelengths—in the range of 1,500 to 1,600 nanometers (*see the chart on page 38*). Highly reliable lasers operating in this "third window" are now being developed that will have greater information-carrying capacity and allow for longer distances between repeaters. These systems will routinely transmit information at the rate of up to 1 billion bits per second over 50 to 100 kilometers, sufficient to carry simultaneously several video channels, high-fidelity audio, data services, and thousands of telephone calls.

Another interesting technological issue in fiber optics is the choice of the switching methods by which information is channeled to individual users. Most of today's fiber communications are point-to-point links, used to transfer information between only two terminals. But optical fibers will soon be widely used in networks, passing information among multiple users. This will require fast, dependable switching and branching functions.

For the predictable future, switching will be accomplished by conventional electronic equipment connected to the ends of optical-fiber links. Optical switching techniques are being studied but are far from ready for use. These range from mechanical devices that simply move a fiber between two or more other fibers—like a conventional relay switch—to sophisticated devices that make use of certain materials that change their density—and hence deflect the light—when subjected to an electric field.

Another technical question for the future concerns

PHOTOS: CORNING GLASS WORKS



Though most of us think glass is fragile, perfect fibers and sheets of highly purified glass are elastic and strong. But glass fractures easily when its surface is flawed even microscopically. Therefore, optical fibers are given protective coatings of polymer immediately after manufacturing.

"wavelength multiplexing"—the idea of simultaneously transmitting through a single fiber signals from several lasers operating at different wavelengths. Filters are used to separate these signals—and their messages—at the receiving end. This seems to be a logical way to increase the already prodigious communications capacity of an optical fiber.

But there are complex tradeoffs between multiplexing and the alternative of adding fiber links to increase capacity. Transmitting several different wavelengths simultaneously in a single fiber requires additional components that decrease the amount of light transmitted and increase complexity and therefore cost. Nevertheless, components to split and combine optical signals of different wavelengths are beginning to emerge, and a "picture-window" fiber that could accommodate light of many wavelengths is being sought.

Another important question concerns the choice between digital and analog transmission. In digital transmission, messages are encoded so they can be transmitted in terms of on-off signals. In analog transmission, the laser light is continuous, with its intensity made to vary according to the information being sent—like conventional radio and television. Digital transmission has higher fidelity but requires more capacity in the transmission channel. Analog transmission requires less bandwidth by a factor of 10 to transmit a similar amount of data. Digital transmission is directly compatible with computer data, and most new telephone systems are being designed to use a digital format. However, the tremendous capital investment of the TV industry and analog's lower bandwidth requirements will spur continued work on analog optical systems. The principle technical problem is finding a light source that can handle analog information with high fidelity.

There is also competition between monomode and multimode graded-index fiber systems, but the odds are beginning to favor the former.

We have focused on optical fibers used for long-distance telephone, video, and data transmission. However, optical communication is now competing with conventional electrical systems in many short-distance applications as well, including interconnecting computers and bringing data to computers from sensors. Requirements here are not as stringent. Transmitters can utilize inexpensive light sources, and larger fibers with somewhat less bandwith and efficiency are adequate. The benefits of fiber in such uses include increased bandwith, smaller size, freedom from electrical interference, and greater security.

Because of the many uses of and rapid changes in this technology, no single fiber or light source can satisfy all present or future requirements. Indeed, the systems designer already has a broad array of fibers and light sources to choose from, with more coming. However, this proliferation threatens to become too great. An important challenge to the industry is to standardize to avoid increasing the numbers of fibers, light sources, and system designs beyond those absolutely required. Without standards, the technology will be needlessly expensive and progress delayed.

Gazing into the Glass Ball

What is the place of this new technology in a future that will see an ever-increasing demand for information?

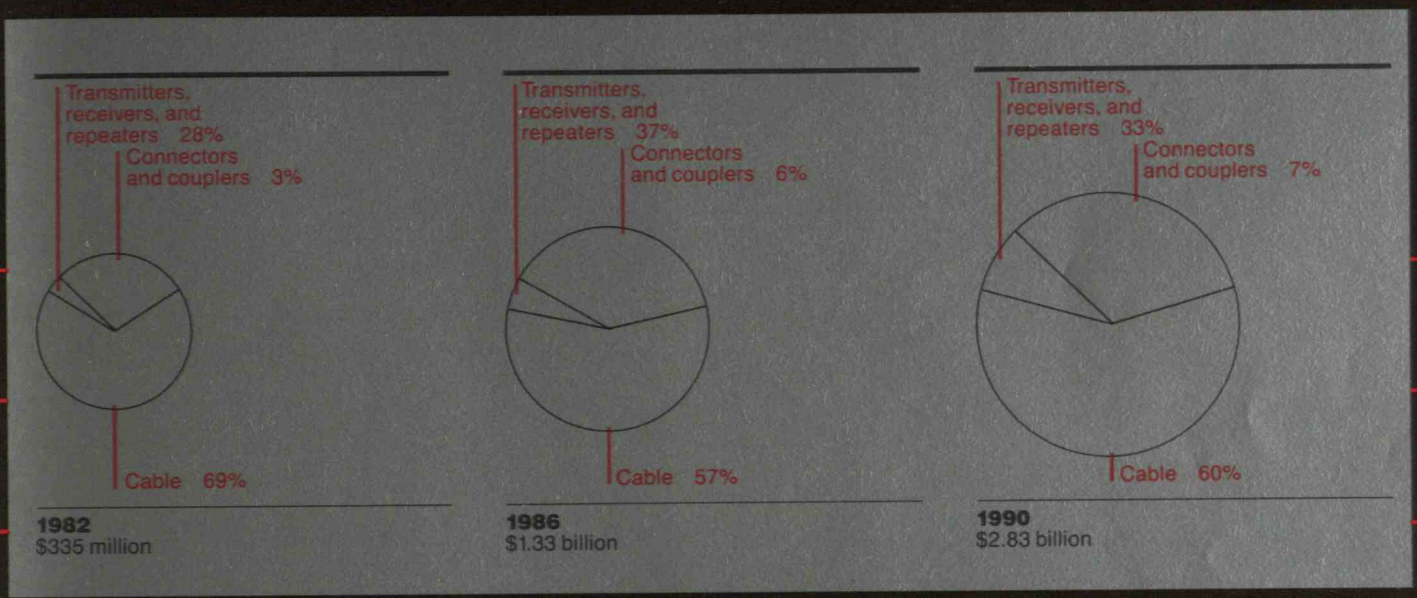
No one doubts that the growth of information services, now approximately 15 percent each year, must continue. But it may soon be prohibitively expensive—perhaps impossible—to add new transmission capacity to our existing channels. Local telephone, cable, and data-transmission lines are crowding our urban cableways, and we are running out of wavelengths on which to carry broadcast, microwave, and satellite links.

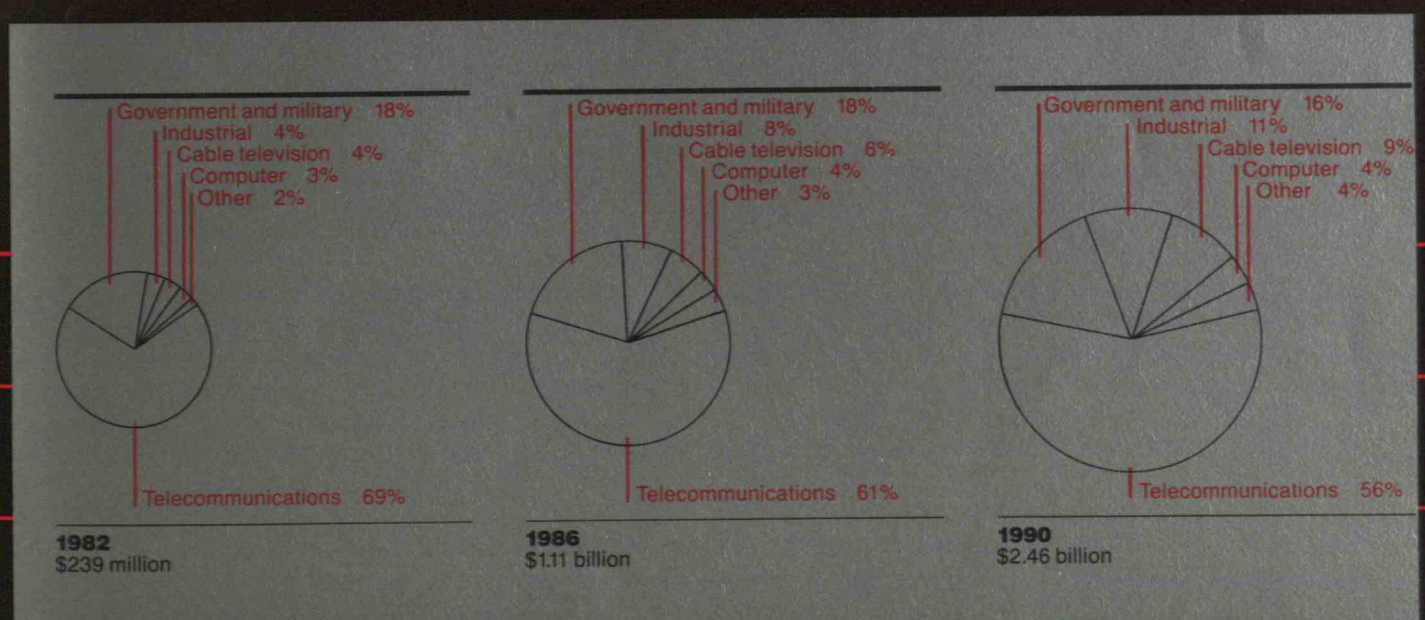
Optical-fiber communication will provide an essential and cost-effective solution to these problems. The impact will be at once dramatic and subtle—dramatic because of the very large increases in capacity that fiber-optic links will provide, but subtle because most users will be unaware that their expanded services are made possible by a technological revolution. The transition to optical communication has already occurred in some telephone trunk lines, where optical fiber now provides more cost-effective capacity than conventional alternatives. In some cases, using optical-fiber links in conjunction with satellite transmission may be the most economical way to add telephone trunk capacity to accommodate data and video as well as voice communication.

When will optical communications become a factor in local services, with each home having its own fiber? That time is moving closer because of the increasing demand for information services and the decreasing cost of optical-fiber systems. Personal computers linked to central processors and videotext systems, including newspapers, magazines, shopping

DIAGRAMS: OMNIGRAPHICS

Fiber-optics communications in the United States and Canada were a $335 million business last year, and that figure will increase nearly tenfold by 1990. Manufacture of the cable itself is the largest segment of the business.





While the business of fiber optics should increase by tenfold in the next eight years, no new markets are foreseen. Additional $2 billion will be spent annually on planning and installation by 1990. (Charts: Gnostic Concepts, Inc.)

services, and central video libraries; monitoring of homes by police and fire officials; direct readout of electricity, gas, oil, and water consumption; and computerized personal financial transactions are now available—or soon will be. Connecting these services to large numbers of individual homes through conventional wire and broadcast channels is almost unthinkable. But a single optical fiber linking a home to a central switching office would have ample capacity.

Such optical links into homes and offices will not be inexpensive. Indeed, this wonderful world of the future may be a hard sell. But as the total amount of information to be transmitted increases, the optical-fiber network will become more attractive. Those willing to use most or all of the many services available will be able to justify the cost.

The Higashi Ikoma Optical Video Information System (HI-OVIS), an optical-fiber communication system near Tokyo, has already transmitted analog video and digital data signals to domestic subscribers. More than 90 percent of subscribers used the system to participate in interactive educational programs such as piano classes, and subscribers also reported stronger community involvement and a widened circle of friends. Indeed, response was so positive that a second-phase system is being constructed to handle 3,000 to 10,000 subscribers by 1985.

Optical-fiber systems will soon be tested in France and West Germany. In Biarritz, France, two fibers going into each of 3,000 to 4,000 homes will be capable of transmitting two video channels, one picture phone, one stereo channel, one data channel, and one normal telephone channel. By 1984, 350 subscribers in seven West German cities will be connected by a network of 2,000 kilometers of optical-fiber cable. Two fibers into each home will provide one picture-phone channel, three switchable television channels, twenty-four channels of stereo, and thirty telephone channels. These initial forays into the use of optical fibers in a local network make it clear that this new technology will dramatically change the complexion of our society within a few decades.

Meanwhile, there are already lively markets for fiber optics in high-density communications systems. The small size, light weight, and freedom from interference of optics will increasingly dictate their use in military and other special applications.

The Irresistible Force and The Immovable Regulation?

This recital of actual and potential uses illustrates why the market for optical communications is predicted to be enormous. Yet because the future cost of fiber cables, lasers, and other devices is uncertain, the extent of this "optical revolution" cannot yet be predicted. One forecast claims that the market for North American fiber-optic hardware will be $2.8 billion per year by 1990, including fibers, cables, and components. If planning and installations costs are included, the total may be two to three times this amount.

Whether this market materializes will depend somewhat on U.S. regulatory policies during the rest of this decade. Though a single broadband optical line would provide capacity for television, telephone, and many other services, television and telephone signals cannot be transmitted on the same network in the United States except in special cases, and broadcasters are generally banned from owning cable systems. Yet using an optical channel for a combination of services may be the only way for an individual homeowner to justify the channel's cost, at least in the near term. Telephone companies, cable-system operators, and perhaps broadcasters may well vie for control of the information flow to homes in a less regulated future.

Domestic applications of optical communication are likely to come sooner in countries where the communications network is government-controlled and multiple services on one network are allowed. The current government-sponsored "wired-city" experiments in France, West Germany, and Japan will undoubtedly prove that bringing multiservice broadband networks into homes is feasible. Thus, it only can be a matter of time until the first economical systems are installed overseas.

The optical-communications revolution has begun its irreversible penetration of our lives.

LES C. GUNDERSON is director of research and development and DONALD B. KECK is manager of the Applied Physics Department, both at Corning Glass Works. Both have made significant contributions to optical communications, Dr. Gunderson in the field of electronic and optical materials and Dr. Keck, in graded-index optics and optical-fiber waveguides.

MIT

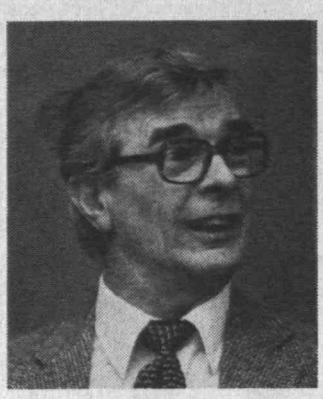
IS · TECH · (STILL) HELL?

"What's so special about an M.I.T. education?" we asked a panel.

Steven E. Barber, '84, electrical engineering and computer science
Ivan K. Fong, '83, chemical engineering
Charles V. Frankel, '82, mechanical engineering
Professor Anthony P. French, physics
Helen Kauder, '83, economics
Jerri-Lynn Scofield, '83, political science
Professor Joseph Sussman, head of civil engineering
Jon P. Wade, E.E.C.S.
Professor August F. Witt, materials science and engineering
Professor John L. Wyatt, Jr., '68, E.E.C.S.

On the next seven pages, their answers.

IS·TECH·(STILL)
HELL?



How does the pressure at M.I.T. affect students?

SUSSMAN: If you want to read about success-oriented people you ought to read some of the admissions folders. I marvel at all the activities some of these people are involved in as high school seniors, at the age of sixteen and seventeen. You wonder if they ever slept for the first seventeen years of their life. They come here like that. The extent to which it is pressure induced by the Institute and the extent to which it is the habit of people who apply here no matter what we do, is not clear.

FRANKEL: I don't think anyone who comes to M.I.T. had a hard time in high school academically. Maybe socially it is another story. But still when you come to M.I.T., it is humbling. You are not the smartest person in your class. You are far from it. There are people who are orders of magnitude smarter than you are. And pressure to perform is an obvious result.

WYATT: The following phenomenon is very commonly observed and would interest a psychiatrist no end: a student at M.I.T. saying "My God, the pressure is enormous here—there is no time for personal growth and it's too much and what am I doing here?" But the very students who say this volunteer to take *more* work than is required—and then complain that they are victimized by this institution.

FONG: The macho nurd.

WYATT: I am a hardliner about how much work it takes to learn things, but there is a question of at what rate you should do it. When I was a junior I decided the hell with it and went to the University of Munich to study comparative literature and ski for a year. I loved it. It took me two extra summers to graduate from M.I.T.

What we should do is create an environment in which students are encouraged to modulate the dosage that they take, and we don't do that for some reason. Everyone mainlines the stuff.

LYON: But they are already selected for those qualities by the Admisssions Office—qualities of wanting to do more.

WYATT: Yes, but nonetheless, they make choices which they say make them unhappy, and they continue to make the same choices, and that is what a psychiatrist would call neurotic.

SCOFIELD: Speaking as I guess you would characterize me as a neurotic, I look back at what I've done at M.I.T. and I've done more than I had to do to get by. It's easy to get caught up in that mode when you are surrounded by very highly self-motivated, supercharged, faster-than-a-speeding-bullet, more-powerful-than-a-ten-ton-locomotive people. It starts at the freshmen picnic: the Institute says "go" and they start to go. All the pressures at M.I.T. push you to keep going, and to go faster. You were the smartest kid in your high school and you are coming to M.I.T.,

Top, left to right: Anthony P. French, Jerri-Lynn Scofield, John L. Wyatt, Jr., Joseph Sussman, Marjorie Lyon. Bottom: August F. Witt, Charles V. Frankel, Helen Kauder, Ivan K. Fong, Jon P. Wade, Steven E. Barber.

ILLUSTRATIONS: ROGER LEYONMARK

and you are carrying the banner of, you know, good ole Newton, New Jersey, in my case, and you are going, going, going, and nobody really ever says to you, "Hey, it's OK to stop. Take a day off." I feel really guilty myself if I take an afternoon off. "Oh my God, I've got two papers due, I've got to get this done . . ."

I'm afraid that while you are actually being a student you only have time to react to what is being thrown at you, and you never really have time to sit down and think "Who am I? Where am I going?" As far as personal growth and development, I think that being at M.I.T. is almost a four-year freeze frame. You are working all the time and you grow very much intellectually, but I don't know if you grow enough personally.

I don't see any easy way to change the system, however, without altering the positive aspects of M.I.T. I'm glad I was given freedom and flexibility to attempt as much as I did. Yet I wish I didn't always feel like I'm on a never-resting treadmill.

FRENCH: I get to the point where I feel guilty if not visibly doing something at every moment. In other words, if I'm sitting and thinking or reading the paper or something like that—waiting for thoughts to come along—that's indecent. I close my office door, if that's what I want to do. That's only partly facetious. I feel that somehow, in my experience there is a discouragement of a truly reflective approach to things, and I think that works on the faculty as well as on students.

WYATT: It works most strongly on the faculty and then it filters down to everyone else. My impression is that too many people here are success-driven, not idea-driven. To strive for success is different from striving for a genuinely new rather difficult idea whose payoff is uncertain, and the investment is quite large. Being success-driven is good for professional activity. But I don't think it is a good way to come up with the difficult, clever, original, oddball new idea that sets the whole shebang off on a different course. Most such ideas fail, but when they succeed, they succeed very grandly.

WITT: What I would like to see is more motivated students. I do not like students not knowing for two and a half years what they came for. It is a waste of time.

WYATT: I think most of the students at M.I.T. are driven. It's not only that they want to learn, but they want straight A's. A lot of students want to go on to graduate school.

FONG: The question to me is whether the motivation comes from yourself or from the outside.

FRANKEL: My own experience is that I was never really driven to get a grade. Along the way there were excellent professors. I reacted so strongly that I worked like I have never worked before. I was completely motivated to learn the material, and I got an A in the course as a side effect.

It's easy when you're doing something you're interested in. But you also have to take courses that

you're not interested in. And that's where the motivation problem comes in; for people who aren't interested in grades as a goal or as a motivator, studying becomes difficult. Then it has to be the teacher or the presentation of the material that keeps them going.

Can Faculty Advisors Help?

WYATT: Lots of students tell me that their advisors simply don't hear what is going on with them. They need someone to listen to how they are stuck. The high pressure puts great demands on the maturity of an 18- or 19-year-old, and some are not mature enough to handle it.

WITT: The problem is that you have some students who badly need advice and are not going to look for it. But I would say that's life, unfortunately. They will leave this institution artificially being carried along under optimized conditions. They go into a different environment; the probability is large that they will sag down again. I do not think that you change basically. I think all we can do at the Institute, or all we should do, is to optimize your abilities, so when you leave the Institute you can use your facilities in an optimum way. The rest of it is up to you.

WYATT: This is a good view for thinking about adults; an adult is responsible for making use of the resources around here. But an 18-year-old is somewhere in between a child and an adult. They do a few things wrong, they make some mistakes, and they get defeated, and it builds on itself. I think for about a third of the students, roughly, it is not a good experience in learning self-confidence and the ability to take a small failure and bounce back.

WITT: In my own course I tell the students at least ten times in one form or another—during one term—anybody having a problem, come and see me. My door is open; you have my home phone number—come and see me. Twelve years and I can count them on two hands. That means that's the way the student is, and you can make a major effort, but you cannot change the individual fundamentally. You can offer him everything, and I think the Institute offers him everything.

FONG: If, however, I go to see my advisor five times and each time he breaks an appointment, I really have no more reason to go and see him.

WITT: But you are a grown-up boy, you can go to the department and say "I want another advisor" and tomorrow you have one. So what's wrong with that? You have to act, not react.

FRENCH: Gus, I'm surprised to find you so tough-minded in your attitude. I am—or was—a shy person, and I am very struck by how difficult it is to be a shy student entering M.I.T. It is a drastic and traumatic change between the environment of a small high school where the teachers know you by your first name and see you every day, and the impersonality of the recitations of 8.01, where at the end of the semester most of the students don't know one another in the same section. I think our system is failing some of the students who don't have the chutzpah to go and demand what they are entitled to.

WITT: Why don't they go? That's what I'd like to know.

FRENCH: I have had the same experience as you, and I expect almost every other faculty member has, and I gave up advertising office hours because nobody ever came. And that's the way it is. I mean, some of us, believe it or not, are terrifying people from the standpoint of a freshman entering M.I.T. We know we are lovable, and approachable, but they don't.

FRANKEL: One reason why someone doesn't seek his or her advisor may be recognition of failure. So many students are so successful that when things aren't going well—the time they need to see their advisor—they aren't motivated to recognize their own personal failures.

WYATT: It is a very delicate moment for this striving person in a competitive environment who has

come to you with a failure. It has got to be handled just right; it is frequently not. And he never comes back.

WITT: I have now a fundamental question. I was a student in London—and part in Germany and France and Austria. There you came to the university and you were on your own. Totally. Tutorial systems where there was somebody taking care of me did not exist. It was my own responsibility. In France—let me give you an example—I studied with Madame Curie's daughter, and when I entered the course there were 35 people. Of the 35, 33 were repeating the course because 33 had failed the year before. And there was not a matter of "that is psychologically damaging to you," there was just "you had better work harder if you want to get through it."

WYATT: Wait a minute. If 33 failed, then you were in the majority by failing. It is a completely different situation.

WITT: But what I am trying to say is, it seems to me we are too often trying to play the amateur psychologist.

Would exposure to the "real world" be valuable?

WITT: A prime motivating force can be time spent away from M.I.T. I've seen nothing but benefits from co-op programs. Students come back freer in approaching professors with problems. They are much more communicative, and have a different attitude. I would almost say that everybody, even in the School of Science, should have a period of confrontation with the realities of life during the four years. And in the same spirit, I think alumni who graduated ten years ago should be able to communicate to undergraduates about their experience. Students have no perception of what life is all about. You form your own opinion on that during these four years and frequently it has nothing to do with the price of eggs—it is something unrealistic.

SUSSMAN: My students come back from periods in industry and they have learned to write a report; to convince their bosses that what they do is the right thing; to stand up and make oral presentations—a variety of broadening experiences that the academic institution is not very well equipped to provide.

FONG: When you work you also get a sense of why you are learning what you are learning in school. I think that is very important. In engineering classes the lecturer walks in and says "on your mark, get set, go," as opposed to saying what possible connection to reality this may have. It is often assumed that you learn *this* equation to solve *this* type of problem. When you go to work it's made clear what practical application there is: I think that's a big reason why students come back from industry with higher motivation.

FRANKEL: I hope to go to business school, and I've been talking with employers. I told them that I am interested in marketing, and they ask, "Then why did you study mechanical engineering?" I'm pretty sure that I did the right thing, because I *wanted* to study mechanical engineering—but there is also something inside that says well, if you want to be in marketing or you want to go into business, why didn't you take accounting and finance courses?

WYATT: There is almost nothing that is always in demand. You have to want to become something you believe in, and do something that interests you. You get an M.I.T. degree and you go out there and find your way to be employed at it.

SUSSMAN: The impression one gets in talking with alumni who graduated ten years ago is that their general reaction is: I could never have predicted in my wildest dreams what I am doing today, based on what I thought I'd be doing when I was a junior or senior at M.I.T. Now if that message could somehow get across to our undergraduates, perhaps they would relax a little bit more on that particular issue.

IS · TECH · (STILL)
HELL?

Pass/fail: is it worth it?

WYATT: I'm adamantly opposed to it. The reason is that I get the students that come out of that system to teach later. When they take 8.02 but don't learn field theory as they should, I have to teach it to them all over again.

There are two different strategies: one is to lower the hurdle; the other is to train people to jump the high hurdle. I think the pass/fail system has lowered the hurdle too much in freshman year.

I agree that this is a well-intentioned effort on the Institute's part to try to get rid of some of the harsh competitive atmosphere here. My view is that it's misguided. I think freshmen simply get the wrong message in the first year: they too easily conclude you don't need to really know classical mechanics, electromagnetic field theory, and differential and integral calculus. But in fact, these comprise your tool kit for the rest of your life. What happens is that all the pain, all the dues are paid the next year for what you didn't learn in physics and calculus in the freshman year.

SCOFIELD: I thought that the pass/fail experiment, with the evaluation forms, was supposed to encourage faculty to give students better feedback about their performance. I think it says to students that it is not how well you've learned Maxwell's equations that is important, but that you are a C in comparison to other people in the class. What I have found most frustrating is that constructive evaluation is often sacrificed and replaced by mere grades. I have spent weeks on a 50-page paper in political science and occasionally gotten it back with an A or B alone. I never knew what I did right, what I did wrong, if I missed a point or didn't miss a point. I think there should be required evaluations of performance in the pass/fail system with no hidden grades. The purpose of grades should be to let students know how well they've learned the material, not to rank them in comparison to others in their classes.

WITT: A student is not a pass/fail; he or she is excellent, good, mediocre, terrible, or no good. If you add to the pass/fail system the descriptive portion, then you have a profile which is more informative than a grade. But what leaves the institution is not that package. What leaves is the pass or the fail. The rest of it is private communication that, unless you request it, won't be delivered to anybody. And it will be destroyed after a certain amount of time. So I think pass/fail is an oversimplification.

Does research interfere with teaching?

SUSSMAN: I think the easy error is to draw an artificial distinction between the research program and the educational program; in fact, the research program is an integral part of the educational process. And research, in addition to being part of the intellectual fabric of the institution, is also part of its financial fabric: faculty members have portions of their salaries charged to research programs as well as academic programs. In my department (civil engineering) the number of faculty members we actually have is very closely tied to the research funding that has developed over the course of many, many decades. The net effect of this is that there are more people at a faculty level. And while the students may in some formal academic sense get less time from any one of those individuals, I would argue that the richness of having a larger available number of people outweighs the academic time problem.

FRENCH: At a prestigious university, the biggest single factor in the decision of who is asked to be on the faculty is the achievement or promise of a candidate's research. Although my own interests are very deeply on the educational side of things—that was my reason for coming here in the first place 20 years ago—I think the emphasis on research is the way it

should be in order to have a healthy operation.

FRANKEL: I agree. I think research is an excellent way for students to get involved with the professor and learn a lot more by doing research than in the classroom.

WADE: I think the main thing is that when the professor is teaching you can perceive his or her excitement for the subject. There are some classes where it is painfully clear that the professor has to be there; he or she wants to finish the 55 minutes and leave. In that kind of situation, I find myself not going to that class anymore. Then, it becomes "I need to survive this course."

WITT: I clearly differentiate between graduate and undergraduate education at M.I.T. If I talk graduate education, I think research is an absolute must—I would almost say the more the better—the contacts, industry interaction, everything. But undergraduate education to me is a dilemma. If I take my own situation: when I am teaching my course during the term, I am up six days a week from eight o'clock in the morning until two o'clock in the morning, and there is no letdown—and that is all course work. So, when do I meet responsibilities to my nine graduate students and three post-doctoral individuals—over the weekend? Somehow, some people can do it, others can't.

I don't like the attitude that when it comes to a tenure decision, one element is how much money does the person bring in in terms of research contracts. That should have nothing to do with the assessment. I also do not like the fact that almost exclusively, research work is taken as a criterion for or against tenure. It is my feeling that, particularly on the undergraduate level, we should have faculty who are gifted in teaching, that focus on teaching. They should not be penalized for spending 80 percent of their effort on teaching.

But for junior faculty members that option doesn't exist. Either he or she produces or leaves. Junior faculty members considered for tenure have to be extremely careful not to get carried away by student contact. During a term there is no way I could take half an hour during the nine-to-five period to do research. And when I look at the junior faculty member, how can he or she do both?

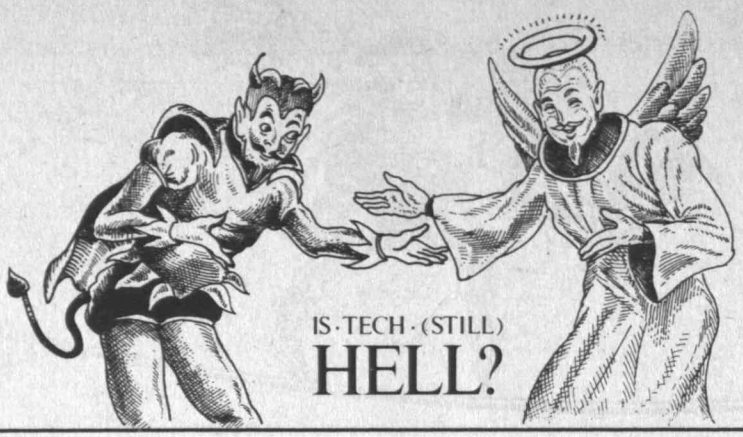
So I think the Institute should definitely change the attitude about rewarding intensity in teaching. If the faculty is not intensively interacting with the students, it is a deficiency, because that is our primary responsibility.

Is there an evolution of a student from enthusiastic freshman to cynical senior?

WYATT: A professsor in chemical engineering told me he really likes to teach freshmen because they ask questions, are very motivated and filled with energy. When he has to teach seniors, they all just sit there passively and want to get through the course. It seems like they are just not very interested anymore.

FRANKEL: Freshmen like to ask a lot more questions than seniors. I think there's a social problem there, in that people who ask a lot of questions get reputations of being nurds. Or a lot of times, they don't ask questions properly or they interrupt the lecturer; or there's resentment by the professor. I've had courses where the professor got all upset, because the student who asked the questions didn't understand what was being presented. And there's a social stigma attached to a person who sits in class and always says "I don't understand."

WADE: I've tended to ask *more* questions as I went through undergraduate years, because the first year I was afraid. I thought all these people are so intelligent, and I'm going to look stupid. Then, after a couple of years, I realized I'm not that stupid, so I can ask questions. For me it was developing self-confidence.



KAUDER: Speaking as someone in the Economics Department, I found the process (from being energetic to doing the minimum) was exactly the reverse. I watched everyone working on the same homework problems as a freshman and felt a lot of pressure as one of the crowd. In the Economics Department, classes tend to get smaller as you progress and so I was more and more on my own. My energy increased in that atmosphere. I began to rely on myself in my individual work, and form stimulating relationships with professors where I can talk to them about their research.

What is the best and worst about M.I.T. from your point of view?

SCOFIELD: The best and worst are the flip side of each other. I think that the best part of M.I.T. is the freedom to hang yourself, and the worst part is the pace, the feeling you have when you realize "Oh, my god—I'm about to hang myself."

WYATT: The best thing about M.I.T. for me is the resources: bright students, bright faculty, good equipment, money, prestige, and "esprit de corps" (people who know they are at a place that really cooks). I'm proud of it. The worst thing is a significant divergence between achievement, success, recognition, and professional motivations on the one hand, and genuine careful thinking through of new ideas on the other. Emphasis is on the former; I think it ought to be on the latter.

BARBER: The best thing is the education, and the worst thing has to be some of the dorm parties, which do reflect on the entire social situation.

WITT: The best thing is the facilities. If you're motivated, the sky is the limit. You can have everything, and more, that you can digest. The worst of M.I.T. is if you're not motivated—you don't get as much help as you should have.

FRANKEL: I disagree. Even if you're not motivated, you can get a lot of help. And I think that's one of the best things about M.I.T. But really the best thing about M.I.T. is that the people here care, on all levels. It's been my experience that M.I.T. exists for the purpose of education for the students. The worst thing is the social atmosphere. A key component of creativity is open communication. And I think that M.I.T. is a very introspective place.

KAUDER: For me, the best thing is that I was able to be very creative in the selection of courses and research opportunities. I was able to major in humanities and was given an unbelievable amount of freedom and encouragement to take courses at Wellesley, Harvard, and a junior year away. The flip side of that is that I had to take 8.02. It conflicted with a course that I felt would have been much more valuable to my future career. I think that is a serious concern of humanities, architecture, and urban studies majors at M.I.T.

FONG: The opportunities at M.I.T. that are available to students who are motivated and the resources in terms of people and physical facilities are very good. On the negative side: I have run into professors who really don't seem to give a damn about their students. The disadvantage is that people think that just because they've met *one* poor professor, everybody is like that. After these students go out into the world, they become very cynical. They lose out just because they think that everybody is out to get them.

WADE: I think that the best and the worst is also the best and the worst of the students. You have the brilliant people out there to exchange ideas with. That's what really drew me here. And you have Harvard, Boston University, a whole enclave of thought. I think the worst is that intellectuals carry a certain amount of insecurity which might be what drives them. Yet this insecurity also restrains communication because people are afraid of what other people are going to think of them. They hesitate to talk about anything besides the weather or football. It's a paradox because those possessing the greatest gifts carry within themselves a prison for them.

Classes

The Marshall B. Dalton Award goes to Floyd Lyon, '42 (left) from Howard W. Johnson, chairman of the M.I.T. Corporation, on behalf of the Corporation Development Committee. Mr. Lyon, president of Halm Instrument Co., Inc. of Glen Head, N.Y., is here recognized for his extraordinary leadership in the development of resources for M.I.T.

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Jim Reber, our class estate secretary, wrote last November that most of his time is occupied in reading, traveling, and golfing. He was then visiting his daughter and her family in Johnstown, Pa., and expected soon to fly to Houston, Tex., to visit his family there, and then to spend Christmas in Johnstown. He planned to drive to Florida after that for four months at Errol by the Sea, a condominium in Smyrna Beach where he's been spending the winters since he left Houston two years ago. Jim kindly invited me to visit him, but I was staying home all last winter.

Maurice (Tim) Root also wrote in November, reminding me that he used to get on the train in Hartford (I started from Waterbury) and ride with me, "to the station back of Trinity Church on Copley Square, in the heart of old Boston Tech." He left the Institute at the end of our freshman year, "and after a year out of doors because of ill health, transferred to Cornell on the seven-year joyride into medicine. During internship at Bellevue, Sophie Andrews from Barnard picked me up and has stayed by me ever since." Tim added that they have "forty-odd progeny to show for the union." They were both physicians in West Hartford for many years, and retired to Rockland, Me., in 1979. In spite of severe deafness, Tim has continued his education by becoming a guinea pig for aging studies at a gerontology center in Baltimore, and that, "along with several other similar projects, has kept me in touch with many modern techniques in medicine and psychology and brought invaluable contacts with researchers, others interested in aging, and a number of wonderful fellow guinea pigs who are now tied into sort of a bund of octo and nonagenarians. I think some of you other old codgers may find it profitable to look into similar ways to 'keep in touch' after retirement."

Late in November I spent a very pleasant half-hour with Marjorie and **Roy Parsell** at their home in North Madison, Conn. They have an attractive and beautifully-furnished house, well back from the nearest road in a large wooded area, remote enough so that deer look in their windows. Marjorie unfortunately had to spend much of last year in a hospital and a nursing home, and Roy has eye problems, but they are getting along well with professional help.

Word came from the Alumni Association in February that **Long Lau** died in Honolulu, his home for many years, on February 21, 1982. I hope to have information for a note about him in later class news.—**Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, CT 06119

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What a delight to have a letter from **Herman Morse**, during his visit to Ormond Beach, Fla. He and his wife, Marjorie, have a very fine daughter, Barbara, and son-in-law, Frank, who drove their car from Akron, Ohio, to Ormond Beach and met Herman and Marjorie at the airport. Herman says, "Ormond Beach is where John D. Rockefeller spent some 25 winters. He gave out a lot of dimes to people he met, but so far I haven't found any in the street!"

Herman also wished me a good recovery, and I am happy to report that hopefully this week, when I go to the doctor, he will permit me to stop using the cane, and after a six months' period I will be back in A-1 shape.

Another terrific surprise was to have tidings from **Mimi (Mary Plummer) Rice**, who also wished me well and informed me that she had a slight stroke last November. She is in a rest home until she can take care of herself. She is able to walk well and is waiting for the good weather to go back to her comfortable, lovely mobile home. She mentioned that it had been raining for weeks and the floods in Sonoma, Calif., had been devastating. Enclosed in her letter was a fine contribution to the 1983 Alumni Fund—most gratefully received indeed.

Had word from Doris Zich that **Larry (Bernard) Landers**, who for many years was an active member of 1915, passed away on January 17. He retired from Philipp Brothers Chemical just five years ago. He and his late wife, Fanny, had no children, but he leaves many nieces and nephews. . . . Clifford E. Sifton, Jr. advises that his father, **Clifford E. Sifton** passed away on May 30, 1981, which, of course, saddens his classmates. . . . Am going to work very soon on my personal letter to each and every one of you, and, as always, love to hear from you. . . . so please write.—**Joyce E. Brado**, "Your old Class Agent," 491 Davison Rd., Apartment 9, Lockport, NY

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On February 11, 1983, our class president, **Ralph A. Fletcher**, departed from this world. We will miss his dedication and devotion to our class, his inspirational leadership, his generous spirit, his friendship. Frances and **Paul Duff** attended the memorial service in Westford, Mass. In this difficult time, the many expressions of condolence from '16ers to Sibyl were heartwarming and comforting, and she will be ever-grateful for your very timely thoughtfulness and concern.

Recently had the pleasure of conversations with **Hy Ullian, Barney Gordon, Paul Duff,** and **Dan Comiskey**, and all seem to be doing well. Dan and Grace had just returned from a visit to relatives in Chicago. . . . Had nice letters from **Chet Richardson, Charlie Reed, John Fairfield, Will Wylde,** and **Henry Shepard**, and they all seem to be doing well.

Some of our classmates are interested in joining the Class of 1918 for their 65th Reunion, June 9-11, 1983. As soon as the detailed information is available, we'll publicize it and get an indication of those who might be able to attend part or all of the reunion. Maybe we can focus on at least one activity. We'll be in touch. . . . Keep eating, drinking, walking, breathing, everything in moderation, and of course, write to us.—**Bob O'Brien**, Acting Secretary, H. E. Fletcher Co., Groton Rd., West Chelmsford, MA 01863

17

On February 4, the severe snowstorm coming up the East Coast hit our Kennett Square area, and a chartered bus trip for a Philadelphia Orchestra afternoon concert had to be cancelled. Fortunately, it was a dry snow, but two feet settled here.

On February 23 the **Stan Lanes** flew to Israel for a visit. They will probably find many changes since they were there in the thirties.

Clarence K. Seely died on March 31, 1982, in Monroe, N.Y., after a long illness. . . . **F. John Kruse** died on May 16, 1982, in Deerfield Beach, Fla., where he lived. . . . **Ernest E. Gustin** died January 19, 1983, in Concord, N.H. He had spent most of his working life in the family wholesale fruit and produce business in Boston. He retired many years ago and had been in a nursing home in Concord for 15 months.

Thomas W. Ryan died February 7, 1983, in Ferguson, Mo. He is survived by his wife Virginia who sent the following interesting account of his life. "What he considered of greatest importance in his life was his religion, his education at M.I.T. on scholarships, his two years of service during World War I with the First Division, First Engineers, and his business career, which lasted until he was 83.

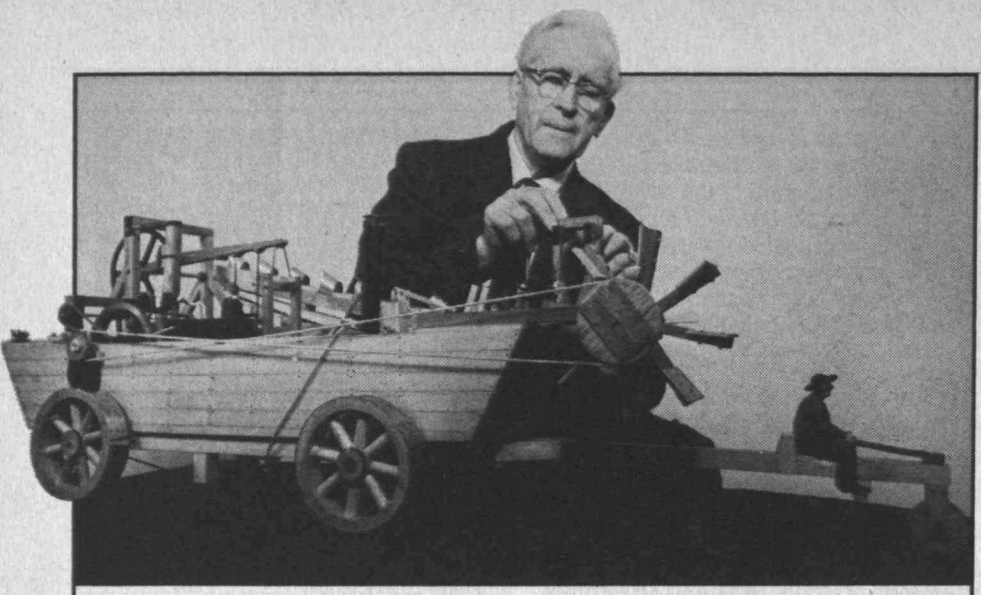
"He joined Thompson-Starrett after the war and spent 26 years in construction. He helped construct the Ambassador Hotel, N.Y., the Waldorf-Astoria, the Sterling Chemistry Lab at Yale, the Ida B. Wells Housing Project in Chicago, and lastly 82 Liberty Ships in Jacksonville, Fla., for World War II. At that time he was the executive vice-president. After that he worked for Basic Refractories in Cleveland, Alton Brick in St. Louis, and spent 25 years as a manufacturer's representative for Owens-Corning Fiberglas.

"At 83 he still loved the gratification of hard work and wouldn't have retired then if it hadn't been for a third hip operation. He was also dedicated to his family. We had five children and nine grandchildren of whom he was most proud, and we are most proud of him."—**Walter J. Beadle**, Secretary, Kendal at Longwood, Kennett Square, PA 19348

18 65th Reunion

In case you did not receive the notice about our 65th Reunion plans, I repeat it here for you. Do make a special effort to come to Tech in June. It will live long and happily with you.

We are looking forward to having all classes who have already had their 65th Reunion join us for our gala event. We have a host of activities planned beginning Thursday night, June 9, with a dinner meeting at Endicott House in Dedham. The



Modeling America's First Self-propelled Vehicle

The most dramatic achievement of Oliver Evans, the prolific 19th-century American inventor, was a steam-powered dredge commissioned by the city of Philadelphia in 1804. The 40,000-pound machine could bring up some 900 cubic feet of mud an hour. But perhaps its most unusual feat was moving itself from its Philadelphia inventor's factory to the Schuylkill River on its own carriage, powered by the same steam engine that would later power the chain of dredging buckets. Intrigued by this story that he had researched in detail, Albert J. Pyle, '23, has now completed a model of the Oliver Evans dredge. Mr. Pyle says Evans was "one of America's greatest early engineers," and he's fast becoming a leading authority on the inventor and his works.

speaker will be Professor Irwin Sizer, former head of the Biology Department, dean of the Graduate School, emeritus, and currently president of the Whitaker Health and Science Fund and consultant for Resource Development. Friday is Alumni Day at Kresge Auditorium with a presentation on artificial intelligence.

Friday night there will be a dinner meeting on the top floor of the State Street Bank building, a skyscraper overlooking Boston harbor. Our speaker will be Walter Rosenblith, who served as M.I.T.'s provost, and is currently an Institute professor as well as foreign secretary of the National Academy of Science.

Saturday morning we will take a bus tour of Boston with a commentary by special guest, John Collins, former mayor of Boston and consulting professor of urban affairs at the Sloan School from 1968-1981. A sumptuous luncheon on Saturday will close the reunion activities at the Hotel Sonesta.

Hotel reservations will be available at reunion headquarters, the Hotel Sonesta on Memorial Drive. For our added comfort and enjoyment, some undergradaute students will be with us throughout the entire weekend to help with arrangements and assist in every way to make us feel at home. Buses will be available for all transportation, and wheelchairs will be provided as needed.—**Max Seltzer**, Secretary, 143 Beacon St., Brookline, MA 02146; **Leonard I. Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146

19

'Tis said, "No news is good news." At any rate, I have no good nor bad news to write. It is, however, a good time to remind you that our 65th Reunion will occur one year from now. By the time of your reading, I hope that you will have some definite particulars on the reunion and that you will be making plans to attend if you are at all able to do so. Hope to see you.

While an undergraduate at M.I.T., I was taught in chemistry and physics about the atom. As I recall it was the smallest particle of matter and I got the impression at that time that it was indivisible. True, I was taught about ions in solution and attended some special lectures by "Charlie" Cross about discharges in gas, but I came away thinking the atom was 'it.' Since then I have noticed quite the contrary, but being busy at many things I paid little attention. Recently, with more time at my disposal, I decided to pick up the subject where I left it at M.I.T. Course VI and get more understanding. As I get more informed, I raise many questions that I do not find answers for. It is fun though, and I thought you might like to know what your class secretary is doing. I would like to know what you are doing, too. Why not write me?

And until next time, have a good summer and get in shape for our reunion. Regards.—**W. O. Langille**, Secretary, Box 144, Gladstone, NJ 07934

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Class news continues to be scarce which can be partially accounted for by winter hibernation. However, we do not excuse our southern classmates and appeal instead to them to send us at least a minimal account of their doings. We hope this finds you in good health and spirits.

An exception is from **Harold Bibber** who writes from Sanibel Island that he continues to serve as a member of the Guidance Council of the Ohio Engineers Foundation. His task is to work with school counselors to acquaint ninth-grade students with what an engineering career offers to and requires of those who enter this branch of activity. Glad to hear from you, Harold.

Perk Bugbee reports that he is collecting royalties from his very successful textbook, *Principles of Fire Protection*, which is being used in many colleges offering courses in fire prevention.—**Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, MA 01890

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The news of **Leon Lloyd**'s death in last month's class notes came by phone call from Russell Ambach, secretary of the Class of 1924 and a close personal friend, after the deadline for sending our news. Consequently, the notes were a little sketchy. Subsequently, his wife Emma sent me a long newsy letter enclosing a newspaper obit and a copy of the church memorial service held on January 15. Besides working for Narragansett Electric, Leon (AI) also worked as manager of the Mystic Power Co. and was a director of the latter company until the late sixties. He retired in 1962. Since retirement, Leon was active in the local and state AARP as legislative chairman. He was a former secretary of the Westerly Merchants Association and served as chairman of the local chapter of the American Red Cross from 1940-1942. His was an active life in civic affairs and for his church.

A brief note from **Josh Crosby** told of "a nice visit from **Winnie Wood Foss** and her husband" during this past winter. The Fosses were spending a week on Longboat Key in Sarasota. Josh also wrote that with the deaths of **Tom Dutton, Larc Randall,** and **Whittier Spaulding** during the past year, he and **Herb Kaufmann** were the only '21ers attending M.I.T. club meetings. Says Josh, "I must try to get **Dick Spitz** to join us."

A letter just in from **Bob Miller** tells of their 50th wedding anniversary celebration and the subsequent cruise that he and Helen took in the Caribbean. The celebration was held on December 29, 30, and 31, with 100 percent attendance of their children, spouses, and 14 grandchildren. All of the grandchildren participated in the church services renewing their wedding vows, and Bob says they turned out to be "the hit of the show." The cruise following the celebration was on the *Sun Viking* of the Royal Caribbean line, voted, says Bob, the number one cruise ship of 1981-82 by a panel of travel agents. Facilities, food, and entertainment were superb and acclaimed by the more than 725 passengers. The Millers are planning to drive up to their cottage on Cape Cod in late May and stop in to see **Cac Clarke** and your secretary along the way. That's all the news this month. How about writing?—**Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, NJ 07450; **Josiah D. Crosby**, Assistant Secretary, 3310 Sheffield Cir., Sarasota, FL 33579; **Samuel E. Lunden**, Assistant Secretary, 1149 S. Broadway, Suite B-800, Los Angeles, CA 90015

22

If you haven't already done so, I suggest reading the fine account about **Marjorie Pierce** appearing on page A9 of the February/March 1983 issue of the *Review*. Is there anyone other than Marjorie in 1922 who has his or her name attached to a piece of M.I.T. real estate other than the seats in Room 10-250? The residence of the Women's Independent Living Group is now the Marjorie Pierce House. The dedication ceremony took place last October. Our compliments to you, Marjorie.

Our M.D., **John Strieder** is still in part-time practice and plays golf in season. . . . Mentioning **Bill Elmer** again may result in my being charged with acting as his PR man. However, I can't help it if he continues to do newsworthy things. Last February at the request of radio station 5DN in Adelaide, Australia, Bill, speaking in Massachusetts, appeared on an Australia 5DN talk show to discuss and answer questions about the SI (metric) system. Bill and an Australian, Peter Thomas, acting independently, are urging the adoption of a 40-inch meter. Thomas had heard of Bill's work on

this subject and was the one to bring 5DN and Bill together. Quoting from Bill's letter, "They (the Australians) are in a state of revolt because their government has buckled under to the mad metric maniacs and made SI mandatory there. Thank God we have been spared a similar fate by Reagan's administration which has killed the metric board."

Records from the Alumni Office show that there are about 300 '22ers still living. No doubt if everyone took the trouble to write, the letters would boil down to something like, "My wife and I are still in reasonably good health, a few aches and pains; we don't travel as much as we used to; we carry on our few hobbies; the children are doing well and the grandchildren are almost all on their own." Or, "We are still living in the house we have occupied for years." Or, "We are comfortably established in a retirement home thereby eliminating all the household chores." Or, "My wife died some years ago, but I am still able to manage by myself." You might think this would sound trite, so it is no wonder so few write. However, it might be of interest to classmates if you wrote to tell briefly some unusual occurrence. For example, "I roomed at Andover in Taylor Hall directly across from Humphrey Bogart. One day we had a fight in my room over some minor dispute. Old Humphrey is long gone but not forgotten." Such comments coming from notable but usually silent classmates might produce a chuckle or two.

No death reports have been received since the last issue.—**Yardley Chittick**, Secretary, Box 390, Ossipee, NH 03864

23 60th Reunion

William B. Greenough, Jr., George A. Rowen, and **Horatio L. Bond,** chairman, comprise the nominating committee for our next five year class officers. They have submitted the following slate: **Royal Sterling**, president; **Bertrand A. McKittrick**, first vice-president; **Thomas E. Rounds**, second vice-president; **James A. Pennypacker**, third vice-president; **Richard H. Frazier**, secretary-treasurer; and **Gerald A. Fitzgerald**, assistant secretary. Voting to fill these offices will be at the class meeting on June 9 at our 60th Reunion. Returns from the preliminary letter about the 60th Reunion indicate an attendance of about 50-60 persons.

A number of deaths have been reported. **J. Allan Abbott** died on November 12, 1982. After graduating in mechanical engineering, his professional life was spent with Homelite Co. He served as sales manager and became president in 1941 and chairman of the board several years later. Upon retirement in 1971 he became a consultant to the company for the remainder of his life. He helped to design and develop the popular one-man chain saw. His lifetime avocation was golf. . . . **Walter Dietz** died on June 30, 1982. He entered the Institute in 1917 but then became a radio operator in the U.S. Navy during World War I as a member of the Naval Reserve. Thereafter, he joined our class and majored in physics. He took S.B. and S.M. degrees in that department. Upon leaving the Institute, he worked at the Watertown Arsenal, then at Westinghouse Electric Research, where he started a photo elastic laboratory with Professor S. Timoshenko. He then left engineering and became a salesman for Electrolux Corp., which was just starting in this country. He continued with Electrolux for the rest of his business life, ultimately becoming president, chief executive officer, and director. He retired in 1957. Walter was an active member of the Kiwanis Club of Delray Beach, Fla., and was mayor of the city during 1961 and 1962. His hobbies were golf, bridge, shooting trap and skeet, hunting, and fishing.

Bernardo Elosúa died in January 1979. He graduated with our class in civil engineering and went on to work for the Southern Pacific Railway of Mexico on a construction job requiring many tunnels and bridges. In 1927 he returned to Monterrey, Mexico, his birthplace, to engage in civil engineering work. In 1929 he became associated with V.L. Valdes, '21, in construction works and in the manufacture of brick and tile. Later he became engaged in the manufacture of plumbing fixtures, plastics, adhesives, and paint. He dealt widely in real estate in connection with the acquistion of clay deposits. He was designated fellow of the American Ceramic Society and received the "Order of Comendador" from Spain.

Richard C. Kleinberger died on January 12, 1983. After graduating in electrical engineering, he was employed by Stone and Webster Engineering Corp. and later became a consulting electrical engineer. He was a registered professional engineer in New York, New Jersey, and Connecticut. During World War I he served with the U.S. Navy. He was also a licensed radio operator.

Charles Tirrell died on October 20, 1982. He studied civil engineering with our class. He pursued a varied career after leaving the Institute, consisting of jobs in the construction field and sales with Sears Roebuck and Co. He retired in 1965 to become a gentleman farmer. He loved swimming.

Harold Van Buren died January 28, 1983. He graduated from the U.S. Naval Academy in 1920, took his S.M. degree in naval architecture at the Institute. He resigned from the Navy in 1925 when the 5-5-3 treaty meant that no new ships would be built for ten years. He joined the Proctor and Gamble Manufacturing Co. in Cincinnati and became division manager of manufacturing, retiring in 1960. He was a member of Engineering Society of Cincinnati, Stone House Yacht Club, and Cruising Club of America. He was also a vestryman of Christ Church in Harwich Port, Mass. His avocation was "anything to do with boats."—**Richard H. Frazier**, Secretary-Treasurer, 7 Summit Ave., Winchester, MA 01890

24

At this writing, February 28, with the thermometer here approaching 60 degrees Fahrenheit and the sun rapidly pushing the snow down the gutters, I do not envy our Florida sun-soakers, **Phil Blanchard, Ray Lehrer,** and **Gordon Billard**. By the time you read this, I hope you will be enjoying a rare day in May.

With regret, we report the death, after years of declining health, of one of our most distinguished classmates, **Frederick E. Terman**, the "Father of Silicon Valley" and retired provost of Stanford University, on December 19, 1982. He was the leading figure in developing Stanford Industrial Park housing 90 firms and 25,000 people. His key talent was recognizing genius and developing it, a Nobel prize winner among them. He earned several university degrees and after two years at the Institute was awarded an Sc.D. in electrical engineering. During World War II, he directed the lab research at Harvard that developed the means for jamming radar, thus saving the lives of thousands of Allied pilots. For that, he was awarded the U.S. highest civilian award, the Medal of Merit and the King of England Special Medal for Service. He wrote *The Radio Engineers Handbook*, often called the bible of the field. He preached the benefits of close industry-university interaction, and he realized that an industry would grow when brainpower served as the raw material.

A note from Virginia Bailey, the daughter of **G. Fred Ashworth**, advises that he passed on December 7, 1982, in Milwaukee, Wis., after a long siege of Parkinson's disease. The uniqueness of his symptoms caused an extended study by the medical profession. Fred earned his S.B. in naval architecture and marine engineering. He joined Stone and Webster sales in the management division. After four years he went with Merriman Brothers near Boston, yacht fittings producers, retiring as vice-president in 1974 before moving to Milwaukee. At the Institute, he was active in the Naval Architecture Society, *The Tech*, and track. He was a director of several Quincy, Mass., community programs.

The widow of **William L. Keplinger** advises of his death January 26, 1983, in Southbury, Conn., after a long illness. Bill prepared at Penn State College and was awarded his S.B. in general engineering. He joined Johns-Manville Sales Corp. after graduating and remained his entire career, retiring in 1966. He and Alice lived in Hempstead, N.Y., later moving to Southbury. He was a cross-country and track man. Also an avid golfer, he became president of the Eastern Traders Golf Association and the New York Chapter, Producers Council.

The Alumni Association sent a copy of the talk, "Culture and the Future," presented by **Luis Ferre** before UNESCO in Paris circa November 1982. It is an erudite recognition of the UNESCO purpose, well stated in his words.—"We would hope that the future direction of UNESCO would be along these lines—attempting to recognize and utilize the rich cultural and educational potential of new technological advances, and utilizing them understandingly." . . . **Don Moore** is trying to lose weight, but in his weakened condition was able to hold up a telephone long enough to tell me that **Ed Moll** has sold his estate in Sunapee, N.H. and will build in the vicinity of New London, Conn. . . . **Phil Blanchard, Ray Lehrer,** and **Gordon Billard** continue to temporarily perform as solar collectors in Florida, along with permanent classmate residents.

Keep in mind that we are only 12 months from our 60th Jubilee!! **Rock Hereford** in Carmel, Calif., was asked to draw up an entertainment agenda but declined as he is writing a biography of a prominent friend. Volunteers or suggestions are most welcome.—Co-secretaries: **Russell W. Ambach**, 216 St. Paul St., Brookline, MA 02146; **Herbert R. Stewart**, 8 Pilgrim Rd., Waban, MA 02161

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A number of classmates have reported via the Alumni Fund office. **John Campbell** notes that he has just finished reading Professor John Sheehan's book entitled, *The Enchanted Ring–The Untold Story of Penicillin*, and he recommends it to all Course V and X graduates. . . . **Don Tabor** writes that he enjoys seeing the world and last summer took his two daughters on an 18-day tour of Italy and West Germany. . . . **Milt Salzman** still finds his traveling restricted because of his wife's invalidism following her accident of some two years ago. Milt is general houseman, cook, nurse, and therapist but does keep up with golf, tennis, swimming, and of course barbershop chorus singing. . . . **Archer Nickerson** sends greetings to all and indicates that he is principally enjoying life one day at a time. He is especially proud of being a great-grandfather. . . . **Russell Grove** reports from Marietta, Ga., that he has just about retired from his legal practice. . . . **Harry Thomas** writes from Columbia, S.C., to say that he is still going strong—jogs daily and plays tennis occasionally. He has given up writing about electronics and is now doing a book on tennis, his other love. He finds South Carolina a delightfully warm and sunny place for retirement. He hopes to make the 60th Reunion in 1985.

A most interesting article about **Phil Glasson** appeared in the *Berlin* (N.H.) *Reporter*. Phil went to Berlin following graduation and was hired as a chemist in the research laboratory at Brown Co. He weathered rough times during the depression and in the middle thirties resumed the position of technical librarian of Brown's research department and continued in that capacity until his retirement in 1964. Through his job Phil first became interested in history and over the years acquired much information and documents on the history of the Brown Co. Following retirement he collected them, organized them, and plans to donate them to the Berlin Public Library. Phil has become a real history buff, was responsible for about half of the historical information prepared for the

souvenir sesquicentennial booklet published by the Berlin Chamber of Commerce. He is presently the president of the Gorham, N.H., Historical Society and is collecting historical material on Berlin, which he hopes to organize and donate to the public library.

When the death of **John Yarmack** was announced, no information was available at alumni headquarters about him. Thanks to Donald S. Loomis, '31, a neighbor of John for some 20 years in San Mateo, Calif., we can report that John was born in Russia. He was graduated from the Gymnasium of Noblemen of Poltara before coming to M.I.T. He later attended Yale University. He spent most of his professional life working in the telephone industry, ATT and ITT. In his later years, he was sales manager of Lorain Products Corp. of Lorain, Ohio. Before the onset of physical problems during his last two years, John traveled extensively.

A news clip provides some information on **Raymond C. Gallagher** whose passing was reported a few months ago. Ray retired in 1971 after 30 years with the Newport Naval Base Public Works Department where he was director of design. He was a member of the Professional Engineers Society and a life member and past president for many years of the Montaup Country Club. He leaves his wife Constance M. (Doran) Gallagher, two daughters, a son, and two grandchildren.

The passing of **Chester A. Boggs** is reported with sorrow. We have little information regarding Chet's activities except that he spent most of his professional career on the West Coast.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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Our apologies for the brevity of these notes which are being submitted well in advance of the deadline due to the fact that tomorrow (February 22) Evelyn and I are leaving for Hawaii and not returning until late March. While there we will try to contact Edna and **Argo Landau** to try to induce them to attend our mini-reunion to compensate for the 55th which they regretfully missed due to an accident suffered by Edna's mother. For the same reason we will try to see **Bill Forrester** while in Maui.

In a recent note **Don Cunningham** says that 30 early responses to his January letter to classmates indicate that nine plan to attend with their wives, seven hope to, and 14 cannot. Since the number coming represents more than 50 percent of early replies, we are assured of a good attendance.

A new address for **Jim Warner** is listed as St. James Pl., 333 Lee Dr., Apt. G-19, Baton Rouge, LA 70808. . . . A reply from **Pete Bellaschi** expresses his regrets as to attending the reunion due to his wife's illness. We have frequent references to his continuing activities in the field of high-voltage electrical developments on an international scale, aided by his facility in the Spanish, French, German, and Italian languages. . . . Fannie and **Crockett Harrison** maintain close ties with their 25-member family. In July the family attended Crockett's 80th birthday party at their farm on 50 acres of forested land, which they hope to continue occupying. Last year they became great grandparents for the first time when their granddaughter, Jennie Granger Ono, came home from Japan with her husband Takahiro to give birth to a son, Yosihiro Joshua.

A delayed notice has been received of the death of **George H. Reith** on April 22, 1982, with no further information. . . . A letter from Mrs. **Willard Vaughan** advises of her husband's death on June 4, 1982. Apparently a previous notice was lost. He is survived by his wife Billie, a son Willard, and three grandchildren.—**William Meehan**, Secretary, 191 Dorset Rd., Waban, MA 02168

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Associate secretary **Larry Grew** has reported receiving a beautiful Korean calendar from **Chungsoo Oh**. Even by sea mail it required 670 won (about $1.14) in attractive stamps. There are six paintings of trees, flowers, and shrubs identified in Korean. Larry thanks Chungsoo for a thoughful reminder of their trip together—Boston to Wianno.

Associate secretary **Bud Cole** received a note from **Dick Cheney** who writes: "We rented a delightful chalet-apartment in Switzerland for four weeks in September and October and rail passed, poste bused, and lake steamered all over that beautiful and awe-inspiring country. We specialized in peaks (Jungfrau, Matterhorn, Schalihorn, etc.) and little ancient walled towns perched on rocky promontories. We visited many little quaint villages in remote Alpine valleys. I am still consultant to the chancellor at the University here in Santa Barbara." Bud writes that the heavy rains have been a hazard to golfers as well as mud-sliding homes. A creek overflowed and washed out two holes.

The address of one of our coeds, **Rosemary Norris Kutak**, has been missing for the past 15 years, and I made an unsuccessful effort to reach her at her last known address. She married Professor Kutak of the University of Louisville. Our files give her only report: "When I received my degree from M.I.T., I thought I was all set for a career as a lady engineer, and it was quite a surprise to have all that struggle with calculus and such culminate in the writing of mysteries. Yet it wasn't such a far cry after all. For the construction of a detective story is really a neat mathematical problem, sort of a differential equation in which all the little clues must add up to the one and only solution. And the chemistry comes in handy, too, when my characters start playing around with cyanide." If anyone runs across any mystery paperbacks by Rosemary Kutak, let a secretary know, so we can try to trace her locale.

Another of our few coeds, **Harriet W. Allen**, graduated in Course VI, then attended four years more at M.I.T. to get a doctorate in 1936 and has enjoyed an active career in education. From 1947-1950 she was chairman of the physics department at Connecticut College; in 1954, American College for Girls in Istanbul; 1956, head of physics department at Western College for Women, Oxford, Ohio; 1960, Wilson College, Chambersburg, Pa.; 1965-1967, lecturer of physics at Keene State College, Keene, N.H. Harriet then lived in Greece, Thessalonika and Athens, with the idea of learning modern Greek, but after four years returned to her native New Hampshire and has resided in Dover since retirement. But she is now attending courses in "dictatorship" and "terrorism" and is active in the movement of protesting nuclear weapons—a true M.I.T. alumna.

We regret to report the death of **Lester B. Woolfenden** on December 19, 1982, in Paducah, Ky. Les retired in 1969 after 42 years with General Aniline and Film Corp. in Calvert City and Texas City, serving as chemical engineer, plant manager, and regional manager. He was on the board of directors of the Paducah Bank and president of the board of Lourdes Hospital. He was chairman of the fund drive committee for the building of the hospital and was president of the 490-unit Forest Hills housing development. Les was a member of Paducah Rotary Club, Elks Club, Audubon Society, and AARP. He was a 50-year Mason, duke of Paducah, and a Kentucky colonel. Les certainly served his community to the utmost and won great respect for his accomplishments. We give our sincere sympathy to his widow, Ethel, and family.—**Joseph C. Burley**, Secretary, 5 Hutchinson St., Milton, MA 02186; **Lawrence B. Grew**, Associate Secretary, 21 Yowago Ave., Branford, CT 06405; **Prentiss I. Cole**, Associate Secretary, 2150 Webster St., Palo Alto, CA 94301

28 55th Reunion

When these notes are before you, the 55th Reunion of '28 will be just a very few weeks away. We can assure you now that it will be an outstanding event. You have had already the list of those planning to be there (now approaching 150). If you have not yet signed up and have any thought of attending there is still time. You can make your reservation by calling me collect. But do call promptly—we want to be sure that everyone is properly accommodated. To those coming: don't forget to bring your cardinal jacket.

It has been the practice to welcome participation of class widows in the various '28 activities. We are delighted that, as of this writing, Ethel Bernhardt, Marjorie Carvalho, Dorothy Goldberg, Judith Miller, Mary Nichols, Mary Russell, Jan Chamberlain Sawyer, and Jo Shiepe are all planning to attend in June.

Marjorie and **Bill Bendz** were in Boston recently to help with reunion plans. Bill took back to Maine with him the old black and white 16-mm movie shots of past reunions (beginning with the 5th!) for review and in preparation for showing at the class dinner. He says they need to be cleaned up (!?!) . . . Anne and **George Palo** spent two days in Cambridge late last fall and visited the Institute. Even at that early date they learned that '28 reunion plans were a topic of discussion. . . . We must congratulate Louise and **Ernie Knight**. They are still enthusiastic cyclists and participate frequently in bicycle events. Their holiday greeting card shows them riding a side-by-side two wheel tandem that must call for more then ordinary skill.

At yearend we had a nice letter from Mary and **Max Parshall**. We are sorry to learn that both have had health problems and feel that they are not up to making the trip to Cambridge in June. They are intensely interested, however, and want a full report on the event. On the day of their 48th wedding anniversary Max was presented with his 50-year Masonic emblem at a special ceremony. . . . We are sorry to learn that Jo and **Al Gracia** also are unable to be with us in June. This is because of Jo's failing health. To both couples we send our very best wishes.

George Chatfield is still going strong. He writes the editorials for his newspaper, the *Montachusett Review*, (48,000 weekly circulation) and has been instrumental in getting I-190, the superhighway (Worcester-Leominster-Fitchburg) finally completed. It was a $250-million project. . . . **Ed Walton** writes that he keeps very busy but has nothing exciting to report. (We think the latter is just his own modest opinion.) . . . Our ever faithful correspondent, **Bill Hurst**, tells us of the alumni dinner he attended recently at the Heritage Club in Houston, Tex. He was well impressed by the speaker, Jerry Wiesner.

With deep regret we must report the deaths of four classmates. **Richard F. Piper** died January 6, 1981. Dick studied in Course XI, sanitary engineering, and for most of his business life was with Baird and Bartlett Co., Brockton, Mass., where he was the company president. Wife Dorothy survives him. They have three daughters and nine grandchildren. . . . **Stanley M. Humphrey** died September 18, 1982. The information was sent by wife Anne. Stan graduated in Course VI, electrical engineering, and was employed in engineering during the early years of his career. Later, he became associated with Booz, Allen, and Hamilton (consultants) where he was vice-president until his retirement. The Humphreys had a son and a daughter. . . . **Onnic P. Susmeyan** died September 22, 1982. His wife, Kay, was both kind and thoughtful in sending us the announcement. Sus graduated in Course VI, electrical engineering, and worked most of his professional life as an engineer and manager in the manufacture of radio and cathode ray tubes. He was with RCA during his earlier years, then with Raytheon until retirement. . . . **Allan L. Tarr** died November 21, 1982. Allan graduated in Course III, metallurgy,

and enjoyed a highly varied professional life that included teaching, research, and consulting in metallurgy, and as an inventor and business man. He was widowed but leaves a son and a daughter.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890

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John D. McCaskey sends his greetings to all his friends and classmates. Please note his change of address: Keen Agers, Room 227, 923 Powell, St. Joseph, MO 64501. . . . **Chung-Foy Yee** of Canton, China, sends a card wishing health and happiness to all. . . . A note from **Larry Moses** of Sarasota, Fla., reads, "Kay and I enjoyed a very special 50th wedding anniversary in 1982. We rented the very cottage in Jamestown, R.I., where we met in 1924, honeymooned in 1932, and visited often while my parents owned it. In 1944 Kay and I and our two sons lived there while I was in St. Johns, Newfoundland, as a base signal officer. This past July we entertained our children, grandchildren, and friends and enjoyed tremendous nostalgia. On October 9 all our family came to Sarasota to host a large party for us and stayed up to a week. Last May the medical specialists diagnosed my ailment as Amploidosis, a rare liver disease. They prescribed chemotherapy, pills, and monthly check-ups. Latest report in December was very encouraging, and I am now enjoying golf, gardening, and similar activities. I have just started my 75th year with real optimism. We count ourselves truly blessed."

The Hudson River Fisherman's Association recently honored **Warren W. Walker** of Montclair, N.J. Warren's company, Graphite Metalizing Corp. of Yonkers, N.Y., received the association's award of excellence for practicing good environmental procedures and cooperating with groups in the area. Warren's company abstained from polluting the atmosphere and from adding pollutants to the Saw Mill River. Yonkers Mayor Angelo Martinelli praised Warren for his civic, philanthropic, and business contributions to the city of Yonkers. Warren is a director of Yonkers Chamber of Commerce, Yonkers General Hospital, and was a moving force behind the effort to save Yonkers City Club, a 100 year-old-landmark, from being sold. . . . **Lawrence Newman** of Delray Beach, Fla., writes, "We consider ourselves fortunate that we are still able to square dance, which we enjoy very much. Last spring we spent three weeks in Greece, two of which were on a boat visiting the islands. In May 1981 we took a North Cape cruise in Norway. This spring, while we are on our way to Maine, where we spend our summers, we may make a detour and visit the national parks out west."

Sam Shaffer of Los Angeles, Calif., writes, "My wife Sybil and I enjoy reasonably good health. I am still quite active in my retirement years, serving with six United Way allocation committees. I am treasurer of our Management Information Systems group with 100 retail members and consultant on financial programs working on several mergers. Sybil complains that the phone never stops ringing." Sam's hobbies are golf, bridge, gardening, and financial programs. The Shaffers have two children and two grandchildren. . . . **Harold M. Weddle** of San Diego, Calif., and his wife Esther have just celebrated their 50th wedding anniversary. Harold reports that he has just reached his 78th birthday and sends best wishes to all. . . . Local newspapers of Holyoke, Mass., recently headlined Daniel O'Connell's Sons, a building contracting firm beginning its second century. Our own **Dan O'Connell**, current chairman of the board, in an interview referred to the depressed condition of the building trade: "You just don't give up, that's all. The important thing in this businesss is to be damn sure you stay in there and give it all you've got." The firm, started by Dan's grandfather 100 years ago, is the 12th largest contracting firm in New England. Over the years the firm has prospered dramatically. Current projects total $200 million. . . . I was pleasantly surprised to get a telephone call from **Howard Pankratz** from California. He and his wife have been living in Riverside, Calif., for quite some time with reasonably good health. Margaret has had both eyes operated for cataracts. Howard recently had prostate surgery but is now doing fine.

Charles W. Sampson writes, "I have one grandson who is a junior at Syracuse University and a second one who is planning to enter college in 1985, most likely West Point. My wife Sigrid and I are enjoying our retirement years.' . . . I regret to announce the death of two of our members. **Theodore S. Alexieff** of Sonoma, Calif., died December 26, 1982. Ted's wife, Gene, writes that Ted died at home after a long struggle with cancer. All their children were present and participated in a memorial service which included individual tributes to their father. She says, "He was each one's best friend, and mine too. As a young man, tennis and sailing were his hobbies, later, travel, theatre, amateur dramatics, and growing roses became his favorites. All his life, music and family care were uppermost in his heart. Greetings to all his '29er friends." Ted was a native of Oklahoma but grew up in the Boston area. He took Course I, civil engineering and advanced ROTC and received his commission in the U.S. Army reserve. During the war, he was on active duty in Europe as a liaison officer with the Allied Group Control Council. Most of his career was with Factory Mutual as manager of engineering.

Walter S. Bennett of Falmouth, Mass., died January 22, 1983. He was a native of Medford, Mass., and a graduate of Somerville High. He took Course I at M.I.T. Walter was self-employed, a manufacturer's representative in the plumbing supply industry. He was a member of Savin Hill Yacht Club. He is survived by a son, Walter S., Jr. and a daughter, Mrs. Neil Scannell.—**Karnig S. Dinjian**, Secretary, P.O. Box 83, Arlington, MA 02174

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Larry Gonzalez has retired from his most recent job as senior project manager of CDI Marine Co. and does not plan to do any more work unless "a very unusual marine engineering or naval architectural problem shows up." He still plays correspondence chess but finds that "the new crop of youngsters seem to be master level at birth." Eileen and Larry are living in Bethesda, Md., and are looking forward to the next reunion. . . . As previously reported, **Alfredo Gutierrez**, his German wife Anke, and their two sons are living in Grainau, which is near the Swiss border. At one time Alfredo made a considerable effort to form an M.I.T. Club of Germany, but German alumni are so thinly and widely dispersed that it is difficult to get them together. Alfredo's report included a rather downbeat discussion of the economy and credit rating of his native Mexico and other Spanish-American countries.

Hank Halberg retired a number of years ago from his job as groundwater hydrologist for the U.S. Geological Survey, Water Resources Division, based in Little Rock, Ark. His retirement activities include foreign language study (Spanish and French) and bird-watching (amateur ornithology) both in this country and in Spanish America. . . . Supplementing last month's item about **Win Hartford**, he and Mary spent three weeks in England last summer (1982) on an elder hostel program. His thumbnail report: "Cultural courses superb; accomodations spartan."—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 85614

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No further news has yet been reported concerning our mini-reunion trip to Alaska.

John Swanton reports that his fourth grandchild, Alice Brown, daughter of Jim Brown, '59, is a junior in the mathematics department at M.I.T. and is headed for early graduation. His 14th grandchild, son of Kenneth Swanton, '73, has just arrived in the world. . . . Thanks go to John for sending news about **Fred Jelen**. Fred is editor of the second edition of *Cost and Optimization Engineering* published by McGraw Hill Book Co. He also edited the first edition which had favorable sales worldwide.

Warren T. Dickinson retired from Douglas Aircraft Co. after 38 years in several areas of engineering and flight test. . . . The sad news this month is the death of my old friend, **Frederic B. Stanley**, on September 15, 1982. I talked with Fred just before our 50th Reunion, and he mentioned that he didn't feel up to attending the reunion. . . . We also mourn **John Lyon Reid**'s death. John was architect for over 700 school and university buildings in California and other states. He received a master's degree from M.I.T. and was on the faculty from 1932 to 1946. Our sincere sympathy to the families of these classmates.—**Edwin S. Worden**, Secretary, P.O. Box 1241, Mount Dora, FL 32757;**John Swanton**, Assistant Secretary, 27 George St., Newton, MA 02158; **Ben Steverman**, Assistant Secretary, 8 Pawtucket Rd., Plymouth, MA 02360

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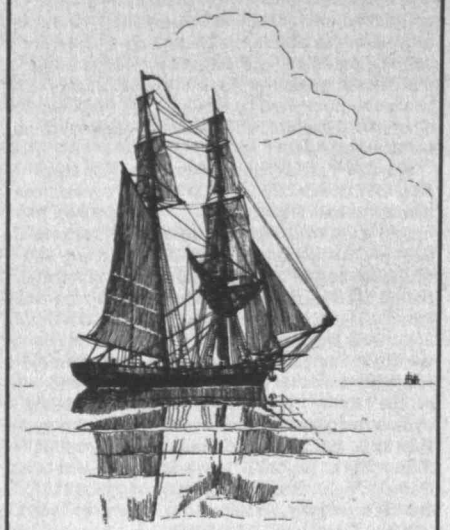
Professor **Caroll L. Wilson**, outstanding member of our class, died of leukemia January 12 in Providence, R.I. He spent most of his career seeking solutions to problems with global dimensions and developed a unique process for involving leaders in industry and government from several countries in global assessments. Many times these class notes have recorded his achievements. Those who knew him said he was a good friend. He was a foreign car buff, an excellent photographer, and enjoyed his house in the south of France. He was able to relate easily to people of all ages. Surviving him are his wife Mary, four children, and five grandchildren. **John Brown** represented our class at the M.I.T. Chapel funeral. He extended our class sympathy to Mrs. Wilson and family.

Rolf Morral celebrated his 75th birthday in June with his wife Lillie, their five offspring, and the grandchildren. Later in the year, they spent three weeks in Sweden and four weeks in Barcelona. In Sweden they attended many family parties, including one for Lillie's mother who was 101 years old and still spry and party-loving. In Barcelona, the Morrels celebrated their 50th anniversary. Rolf put the finishing touches on volume II of his *Metalurgia General*. Volume I was introduced at an educational meeting by the minister of education. The Morrels had some long visits with Maria and **Juan Serrallach**. Juan is recovering from heart surgery and is disappointed at missing our 50th Reunion, but he plans to attend the 51st this June in Cambridge. He sends his greetings to all his friends and classmates.

Ed Nealand writes that he and Ellie are enjoying their Florida stay at Sugarmill Woods in Homosassa. **Bill Pearce** and Midge live close by, and the **Don Brookfields** join them often for socializing and golf. Ed says his experience going south on the *Scandavania* (which takes 400 cars) was a most pleasant one, and he will return to Cape Cod in early April.

Russell Robinson participated in sailboat races at San Carlos, Mexico. Because of heavy gales he and four others lost their masts. The follow-up cruise was called off. . . . **Russell Abbott** complains he was all set to go to the 50th Reunion but did not receive any notice. WOW! Our humble regrets. Make sure you get to the 55th. . . . Reverend **Winthrop E. Robinson** and his wife and their two daughters celebrated their golden wedding anniversary last fall by a visit to Sri Lanka where they were missionaries years ago. . . . It is with regret that we note the death of **Joseph T. Cimorelli** on June 21, 1982, in Morristown, N.J.—**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907



Most of those who knew the late William A. Baker, '34, knew him as a marine historian—an advocate and student of the world's sailing ships and the creator of a number of replicas distinguished by their accuracy and honesty. Only a few of his many admirers knew him as an artist—for example, this drawing of the brig Boxer. *More know now—the result of a memorial exhibition of drawings, plans, etchings, and models organized by the M.I.T. Museum and displayed this spring in a section of the Hart Nautical Galleries, Building 5. After a 30-year career as draftsman and naval architect, Mr. Baker was curator of the Hart collection from 1963 until shortly before his death in 1981.*

33 50th Reunion

Leaders of our fund drive are very optimistic about our final goal. It looks like we may exceed that goal and that our total figure may be listed among the very highest of the reunion gifts for early classes. So, if you have not yet made and paid your pledge, there's still time. Send it now to the M.I.T. Alumni Fund Office.

There are many of you who still may not know that **Fred Murphy** is our acting class president, following **Ellis Littmann**. Fred has carried on admirably. We have word from **Bill Harper**. Bill and I were very close as students, and the affair has endured. . . . **O.H. (Herb) Somers** writes from Tenants Harbor, Me. He lived in Wayland, Mass., until he retired and made the Harbor home a year-round affair. He is now comfortable, secure, and happy. He sails, fishes, gardens, snowshoes, skis, plays tennis and bridge, and travels.

Werner Bachli writes to say his daughter Heidi graduated from Providence College last June. He recently celebrated his 80th birthday. Last August he went to Zurich, Switzerland, and Linz, Austria where he hiked with two companions. Werner observes that other than a cold or two the family has been remarkably healthy. . . . **Dick Morse** recently wrote an article, "Give Government Research Back to Entrepreneurs," in which he says that federal research laboratories have no business working on gas heaters, solar power, or similar programs that compete with private sectors. . . . **Harry Summer** is still with Bell Howell. He has one son going into practice as a physician in New England. Another son, living in Seattle, has a fine baby girl, so Harry becomes a grandpa.

George Stoll tells me he and Jane have just returned from a Caribbean cruise. He made 14 island stops, plus a 125-mile trip up the Oronoco River in Venezuela. George reports he found, upon return, that two classmates had passed away: **William A. Soley, Jr.** in 1982 and **John W. Powers, Jr.** in 1978. . . . **Bill Moran** spends a lot of time helping a group of senior citizens. He and his wife, Barbara, are in top shape, playing a lot of tennis. . . . **Bill Herlich** is retired and spends most of his spare time volunteer working for the Association for Retired Persons. . . . **Mel Ehrlich** retired in 1977 and does consulting in lubrication problems. He is a founding member of Princeton M.I.T. Club, president last year. . . . **Fred Walker** writes that his wife had a severe stroke last year but is making an excellent comeback. Progress, at best, is slow. . . . **Phil Cook** says that he and Loraine spent four weeks in Ireland last June, with a side trip to Wales. They love both countries very much. In September and October, they visited the West Coast and saw their son, Allen, who lives in Portland, Ore. Their health continues good. . . . **Bob Forbes**' family went to Fort Lauderdale, Fla, last spring. Bob has survived complications from by-pass surgery, as well as a bout with reactive hypoglycemia. . . . **Dick Payzant** says that he has been living in the Northwest since 1980. He is now a golf player. . . . **Bob Dillon** writes that he is now an elective vice-president of the Carbide Retiree Service Corps, a non-profit group founded by Union Carbide Corp. . . . We have just been informed that **C. Wallace Bohrer**, of Washington, D.C. passed to his reward. He is survived by a daughter, Mrs. Mary E. Losehoff.

This report, as we near our 50th Reunion, is my last, due to health. Common sense tells me to cease and desist. I have just returned from three weeks in the hospital and am now living alone in my apartment with meals served by the St. Andrews Estates. Fortunately, my daughter Phyllis lives close by in Delray Beach. Sons have their uses, but loving daughters have your heart. From now until new class officers can be elected, **Beau Whitton** will be our acting secretary. You can write to him at 5150 Sharon Rd., Sharon Towers, Charlotte, NC 28210. I have enjoyed the job of secretary all along. You who have been my loyal friends for so long are many, and this is not good-bye but rather au revoir. I wish you all everything that is good.—**Warren J. Henderson**, 6015 S. Verde Trail, St. Andrews Estates, L-315, Boca Raton, FL 33444

34

News is somewhat slim this month, but at least I don't have to report any losses—a real pleasure. . . . An Alumni Fund note from **Al Rogowski** confirms what so many of us have found—that it's often hard to find time for "retirement." He writes, "Since I retired a year ago I haven't yet figured out how I was able to spare time for work at the plant, with all the things one has to do around the house. Attended a seminar on personal computers last June at Class Day. I found there has been an alarming increase in the things I know nothing about!" . . . **Max Winer** says, "Retired from service as an engineer with the Commonwealth of Massachusetts D.P.W. in July 1982. Started a new business, Research Engineers. The firm is concerned with civil engineering work on highways and bridges and the sale of chemicals and plastics." . . . **Adolph Warsher** had been a widower for two years. In August 1982 he married again. He is still employed full time at the C.D. Draper Laboratories in the Navy FBM Department.

On the home front, we had a pleasant week's trip to Guadeloupe the first part of February. It was one of the International Weekend tours that are announced through the M.I.T. Quarter Century Club. Last year we took one to Martinique. Except for charter plane snafu, we have found the trips pleasant and relatively inexpensive. Our weather was better this year, so we spent more time on the beach and in water that was a far cry from Cape Cod Bay at this time of year. Guadeloupe is really two islands separated by a narrow salt river. One, Grande-Terre, is flat, grows sugar cane, and contains most of the hotels as well as the major commercial city, Pointe a Pitre. The other is Basse-Terre, quite mountainous and with rain forest where bananas are grown. Also, on Basse-Terre you find the quiescent volcano, Soufriere, and the administrative capital of the islands, the town of Basse-Terre.

We have found out that winter trips make a pleasant break.—**Robert M. Franklin**, Secretary, P.O. Box 1147 (620 Satucket R.) Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD 20015

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It's always nice to be able to pass along a letter such as the latest from **Bud Pflanz**: "I really can't say 'Greetings from the land of sunshine and clear blue sparkling skies,' as ever since my arrival in my new location the skies have been overcast or dark clouds crowning the mountaintops, with three snow storms, one of ten inches. First time in a decade. Who said Arizona was the sun (or was it fun?) state? T'aint funny when one's incoming waterline freezes or when the pump and the filter of the pool freezes solid at 5 a.m. because some dummy (me) forgot to turn it on at sundown. Oh well, I've experienced worse in various parts of the world during my mediocre army career. At least this was the first Christmas in ten years that I've spent with all three of my children, so it was a happy joyous occasion in spite of the weather. My new abode is a small three-bedroom house. If I were a tobacco chewing type, I probably could spit from one end of the house to the other. It has a view of an 8,000 foot mountain peak of the Huachua Range which is about five miles south of me and about two miles from the Mexican border."

Goffe Benson and his wife Marie hosted a mini-reunion at their home in Pound Ridge, N.Y. on January 29 attended by Mary and **James Parker** from Riverside, Conn., and Frances and **Gregory Fry** from Fairfield, Conn. . . . Marian and **Philip Johnston** have written to 34 '35ers in Pennsylvania and Delaware to try to arrange a strictly social get-together around the middle of May in the Philadelphia area. I shall pass along any news on that later. . . . **Leo Dee** is trying to get the eastern coast of Florida '35ers together for a mini-reunion at Boynton Beach. I shall have more news on that one also. . . . The 1982 Class Golf season finally ended when the finalists in the TOM (Try Once More) flight ran into cold and snow sometime last December. For the record, **Arthur King** and **Henry King** were declared co-champs.

I personally achieved a new height—at last nights annual invitation banquet honoring the new pledges at Chi Phi, I became the oldest alumnus present for the first time! I had a chance to show off the new gold 50-year pin Chi Phi headquarters had sent to me! I'm in line for the 75-year pin in 2005. How many of you will be out there still reading these notes? . . . Golfers, if you have not heard from me by the time you read these notes, please call me to add yourself to the 23rd annual tournament. Nongolfers, please write and don't hold back if you have feelings about too many golf notes.—**Allan Q. Mowatt**, Secretary, P.O. Box 92, Newton, MA 02195

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Regretfully I report the death last December 11 of **Norman A. Cocke, Jr.** of Myrtle Beach, S.C. Norm was born in Charlotte, N.C. In 1938 he

joined American Viscose Corp., and except for time out for the army from 1939 to 1945 he stayed with them until his retirement in 1974. He is survived by his wife Barbara (304 Pine Needle Dr., Myrtle Beach 29577), two sons, Norman III and David, and two brothers. . . . **Laddie Reday** noted with his contribution to the Alumni Fund that *he* had spent a few weeks at Oxford University last fall, so that anonymous postcard was undoubtedly from him! His business, Newport Properties, seems able to spare him for such forays, including January skiing in Austria. . . . **Ham Nigel** in Charleston, R.I., spent a busy summer last year entertaining six grandchildren in shifts. That's what happens when you live in an interesting place!

Albert Del Favero retired some years ago from the construction business in Nashville, Tenn., and recently moved to northern San Diego County, which he thoroughly enjoys. (By the time this appears in print, the move will no longer be "recent.") . . . Here we are 40 percent of the way from our 45th to our 50th Reunion.

I am sure that much of interest has happened to many of you since you supplied Laddie with the biographical information. How about bringing me up to date on what you are doing now?—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, CT 06091

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Stanley D. Zemansky was city purchasing agent for Baltimore since December 1970 until he retired in June 1982. Before 1970 he was director of material, Aerospace Group, Martin Marietta Corp. of Baltimore. Stanley's son Les who has been teaching since 1965, has endowed Stanley with 2 grandchildren—Michael, 11, and Beth, 14. Son Gil is presently completing his Ph.D. dissertation at the University of Washington at Seattle. Daughter Sandy, graduated from M.I.T. in anthropology, had a year at Dag Hammarskjold College in International Studies and followed that by a stint at Bryn Mawr teaching physics. She then decided for the law, graduating from Vermont Law School in May. She is now in California preparing for the next Bar Exam. Wife Anne, who had her hands full caring for the family is once again involved in designing houses—this time a retirement home for the Zemanskys. . . . **Edward V. Corea** reports that he heard from a mutual friend that **Allen M. Swift** died on February 27, 1982. His wife and daughter live at 2903 Wild Horse Rd., Orlando, FL 32807. . . . **John B. Nugent** writes, "I just received my Ph.D. in Physics from Caltech and am working at TRW in Redondo Beach, Calif."

John Jacobs writes, "We were in Calgary for 14 months. I worked on an LP model for Shell. Worked hard, played a lot of racketball and windsurfed in the Heritage Park Reservoir. In May 1982 I retired from Bechtel in order to 'hang out.' that summer I played racketball, windsurfed in the bay and did some hiking, and started a microcomputer consulting business. However, since October I have been working as a consultant for Bechtel developing a Monte Carlo simulation for a coal slurry pipeline project. This was a part-time project which soon became full-time. Elizabeth wants to know when I am going to retire from being 'retired.' She has had a good year and has done some great sculpture. She has had two recent pieces in an art show in the city. Jeep is very happily married and a successful business executive. Karen is still a starving writer and is captain of the national champion underwater hockey team." . . . **Philip Bliss** was recently elected to the grade of Fellow by the Instrument Society of America. He joined I.S.A. in 1955, attaining senior member grade in 1959. He became a life member of the Society in 1981. He has served as president of I.S.A.'s Connecticut Valley Section, education chairman for District 1, and standards and practices chairman for the Metrology, Aerospace, and Test Measurements Divisions. Presently he conducts his private consulting practice in Newington, Conn. He is also a Fellow of the American Society for Testing Materials and a life member of the Institute of Electrical and Electronic Engineers.

Joe Keithly wrote **Phil Peters** on the 50th Reunion Gift activities: "**George DeArment** and I journeyed to Philadelphia and attended the M.I.T. Alumni Officers Conference, where we participated in the seminars on fund-raising and discussed our specific tasks with Hugh Darden (M.I.T.'s principal fund-raiser) and Neil Didricksen (associate director of the Alumni Fund). We learned much and I feel we are off to a good start. George and Neil have prepared lists of people who have expressed interest in M.I.T. in the past few years, and we are now comparing lists. George plans to visit **Al Busch** and ask him to join us in the gift campaign. Neil, further, has organized a meeting in Cambridge for a number of us involved in the 50th Reunion Gift project to discuss approaches to our problems and work out plans for success. All gifts from the alumni of the Class of '37 after July 1982 will be counted as part of our 50th Reunion Gift."—**Lester M. Klashman**, Assistant Secretary, 198 Maple St., Malden, MA 02148; **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, MA 02155

38 45th Reunion

We hope everyone has signed up for our best-yet Reunion and Clambake—June 9-10, Cambridge, and June 10-12, Wianno Club, Old Cape Cod.

Phil Sellers writes that he retired early in 1981 and, after searching for a good retirement spot, moved last August to River Hills Plantation at Lake Wylie, S.C. Much to his surprise, he found that Marion and **Frank Atwater** had been there for about eight years; they have been getting the Sellers into local affairs.

A note from **Howie Millus**: 'Completing second year of retirement from Millmaster Onyx. Busy teaching tennis and coaching the Ladies' Doubles Team." Howie is also studying drawing, oil painting and art appreciation at Union County College. Once a student, always a student. . . . Last March **Al Wilson** attended and was one of the speakers at the AISC National Engineering Conference in Memphis.—**A. L. Bruneau, Jr.**, Secretary, 663 Riverview Dr., Chatham, MA 02633

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Don Donatello says pig slop and fowl food may not interest most people, but they are his bread and butter. The *Anchorage Daily News* published a two-page feature describing Don's achievements as creator of one of Alaska's biggest manufacturing companies, which grosses about six million dollars annually from the manufacture and sale of feed and fertilizer products. Don left the Air Force after World War II to start a new business making bleach in Alaska. By 1965 Don's businesses had expanded so remarkably that President Lyndon Johnson presented him with the Small Business Administration's "Businessman of the Year" award. . . . **Burns Magruder** has retired after 37 years with Dupont. He and Beatrice plan to divide time between Wilmington and Barnstable on the Cape—which is within handy commuting distance of next year's Reunion. It would be fun at the Reunion to hear Burns and Don Donatello, both chemical engineers, reminisce about their careers in two corporations which are at opposite ends of the chemical manufacturing spectrum.

Walter May has been named a Fellow Grade Member in the Automotive Hall of Fame. During his 43-year career with Mack Truck Co., Walt was granted 22 patents and he co-invented the Maxidyne-Maxitorque powertrain—acclaimed as the greatest breakthrough in diesel truck technology of the era. Walt's citation is a high honor reserved for those who reach exceptional professional distinction by virtue of sustained accomplishment in automotive engineering.

Aletta and **Bob Touzalin** completed a European tour which included shopping in the diamond sales rooms of Amsterdam and running a canal boat for two weeks on the canals and rivers of England's midlands. Another tour brought them here, where Billie and **George Cremer** joined us in re-introducing them to the joys of living in this "garden spot of the universe." Bob brought news that Helen and **Bill Murphy**, now retired to Clearwater, Fla., recently enjoyed an ocean cruise on a 12-story liner. Before the Touzalins left, we tried some pitch and putt on a nearby three-par course and we report no eagles scored on that day.—**Hal Seykota**, Secretary, 1603 Calle de Primra, La Jolla, CA 92037

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Our recent request for information is beginning to produce news about some of our 41 missing class members. Augustus Rogowski, '28, called from Needham, Mass., to tell me that he hears from **John R. Divers** occasionally. John has been quite ill. His address is 868 Larchmont Ln., Lake Forest, IL 60045. . . . **Al Guttag** wrote regarding three missing members: Mail sent to **Alfred J. Green** since 1973 has been returned; **Joseph Blackman** is living at 1228 West Laurelton Parkway, Teaneck, NJ 07660; and Al believes that **R. R. DeArellano y Cano** was killed in Cuba at the time of the Castro takeover. Al is still active with the law firm of Cushman, Darby and Cushman. He also managed to run 2,500 miles last year.

A note from **Joe Greenberg** indicates that he has retired from A. T. Kearney in Chicago, but still works part-time as a consultant. He plans to teach a new course in facilities planning at Illinois Institute of Technology this year, and will also publish two books on industrial furnace design through ASM. . . . **Ray Keyes** departed from Westinghouse Hanford Co. approximately a year ago. Since then he has been working at Washington Power on their No. 2 nuclear power plant—a job which he expects to end shortly. Then he will become active in his "rocking chair" and reminisce about bygone days at Tech. . . . **Don Monell** has a practice as an architect and landscape planner in Gloucester, Mass. He recently took an interesting trip aboard a 40-foot sloop: Gloucester, New York, Erie Canal, Great Lakes, Chicago, Illinois Waterway, St. Louis, Mississippi River to New Orleans, around Gulf Coast, Florida up East Coast to Gloucester. He plays tennis regularly and is building another DN iceboat.

Ralph Thompson retired as senior vice-president of Thiokol Corp. on October 1, 1982. . . . **Leonard Weaver** retired from Bird & Son in February 1982 and is now enjoying a life of non-scheduled activity. . . . **Ed Wallace** reports that after being an entrepreneur for 34 years, he sold his business, Wallace Manufacturing Corp., Enfield, Conn., to Omark Industries, Portland, Ore. Ed will continue with the company, primarily as manager, and leave the risk to others. The company manufactures a wide range of grass, pruning, hedge and lopping shears, most of which have patented features. Products are marketed under Wallace and Quick-Kut brands, as well as private label.

Received a call from **Ted Kingsbury**, who informed me that his wife, Edith, was in the best of health—to paraphrase Mark Twain, the reports of her death were greatly exaggerated. Ted's father (Ted is a Jr.), who also was an M.I.T. grad, died several years ago. The death reported was that of Ted's mother, not Edith. My humble apologies to Edith and Ted.—**Donald R. Erb**, Secretary, 10 Sherbrooke Dr., Dover, MA 02030, (617) 785-0540

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John Sexton, president of our class hosted a Faculty Club luncheon to honor **Edward R. Marden**, our president for over 30 years. Natalie Marden, **Reid Weedon**, **David Howard**, **Leona**

Zarsky, and **Joe Dietzgen** presented Ed with a small modern bronze sculpture.

Leona Zarsky, a featured speaker at Women's History Week at M.I.T., recently acquired another master's degree (in management of human services) at the Heller School of Brandeis University. She now is assistant professor of human development at the Hellenic College, Brookline, Mass. . . . **David Saxon**, president of the University of California at Los Angeles has become chairman of the M.I.T. Corporation, succeeding Howard W. Johnson. David earned his S.B. in physics, worked at the M.I.T. Radiation Laboratory from 1943-1946, receiving his Ph.D. in physics from the Institute in 1944.

Hank Avery, our amiable, long-term class secretary, has handed over his baton, ball-point pen, whatever to **Joseph E. Dietzgen**, past president of the M.I.T. Club of Cape Cod. "Zep" urgently begs you to mail pronto your postal cards concerning your job, retirement, grandchildren, travel, sports, whatever, because your fellow classmates have fun reading a small entry in every issue of the *Review*.—**Joseph Dietzgen**, Box 790, Cotuit, MA 02635

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A great picture appeared in *Tech Talk* of **Floyd Lyon** receiving the Marshall B. Dalton Award from Howard Johnson. The award recognized Floyd's extraordinary leadership in resource development. Translated into English, this was the Corporation Development Committee's recognition of Floyd's great work on our 40th Reunion class gift. . . . A long and newsy letter from **Charlie Stempf** from far off Australia. Charlie describes his family as "dinkum" Australian entities, so I guess he finally has gone native! . . . **Charlie Smith** has relinguished the position of chief executive officer of SIFCO Industries but continues as chairman of the company. Charlie's son, Hudson, was elected treasurer of SIFCO so all of you who own stock can be sure that the company is still in good Smith family hands.

Our acid rain guru, **Alan Katzenstein** appeared on the NBC Today Show on January 14. Al's booklet on acid rain has made him a celebrity to those who are on the side of defining the actual impact of acid rain and has made him a villian to many environmentalists on the other side of the issue. Al's technical counsel, he reports, is **Shep Tyree** who assures all that the alleged link between sulfate and acidity doesn't really hold up under the elementary rules we were taught in Chemistry 5.01 and 5.02. Al claims he is now out there working a public relations approach to the problem rather than "holding umbrellas over fish!"

Our happy retirement department continues to grow. **Bob Cunningham** writes, 'Finally coming down from the clouds (I'm kin to those on the top of the Green Building) and into semi-retirement —a new world." . . . Also, **Bruce Anderson** has retired after almost 37 years with UJM Corp.'s Emhard Corp. His most recent position was vice-president of the Emhart Fastener Group. Bruce's immediate plans are to ski for the rest of the winter (this was written in January) and to take up golf in the spring, continuing with tennis and swimming. Shirley and Bruce plan to stay in Wenham and do some traveling. . . . The third retirement is of **Leo Wilson**, who left General Dynamics Corp. December 31, 1982, after 29 years there. He said that he had a nice visit with Jesse Van Winkle in Santee, Calif. With this "mention" Jess, how about sending in some news?—**Ken Rosett**, Secretary, 191 Albermarle Road, White Plains, NY 10605

43 40th Reunion

Reunion Chairman **Jim Hoey** is deeply distressed that everyone has not yet registered for the 40th Reunion, June 8-12. We have some special events planned for Thursday, June 9: a tour of the new Whitaker medical facilities; lunch at the Faculty Club; visits to Quincy Market, the waterfront, and the New England Aquarium. This will be a memorable party, with classmates coming from everywhere, and we should all be there to enjoy it. . . . Meanwhile, Reunion Gift Chairman **Stan Proctor** is working against the clock to close the contribution gap in the 40th Reunion Gift figures. If we are to meet our $500,000 goal to establish a Class of 1943 Career Development Professorship, we need more money. To be specific, we are looking for one pledge of $50,000, three pledges in the $25,000-50,000 range, 14 of $10,000-25,000, 15 of $5,000-10,000, and 50 of $1,000-5,000. Stan is hoping for gifts from at least 80 percent of the class. Remember, all pledges can be paid over a period of five years. You could never have a better feeling about a better cause.

Bill Maxwell reports that he and wife Sammy, who were married for 24 years, had four children, and then were divorced for 12 years, are now remarried and living happily in Upton, Mass. . . . After 39 years with RCA, **Bob Handler** retired in April 1982, and apparently has not missed a day on the golf course since that time. He and wife Marie live in Lancaster, Pa., where he practices his strokes and assists in the operation of Meadia Heights Golf Club. As club president for 1983, Bob offers to get fellow alumni on the course, but he exacts a price—an 18-stroke handicap. If Bob can tear himself away from golf, the Handlers want to do some traveling and enjoy their four grandchildren. . . . Jim Hoey has uncovered an eight-year-old clerical error in the Alumni office. Through some oversight, **J. Barrie Mackenzie** was left out of the 1975 *Alumni Register*. To rescue him from the undeserved status of nonperson, let it be recorded that he was in the seafood business, and is now located in Manchester Center, Vt.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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George N. Ziegler reports that he is "enlivening retirement by independent practice as patent attorney for independent inventors." . . . **Arthur F. Dershowitz** writes that he is "still with G.E. Corporate Development and Planning in Fairfield, Conn. Am now grandfather, courtesy of William, '77. Elder son Dan '76, received Ph.D. in Chemical Engineering in May." . . . **Arturo M. Morales** notes: "Economically it has been tough for us here in Mexico during the last six months. Since getting a Distinguished Member Award from the Society of Mining Engineers of AIME and a few lectures, I am in *Who's Who in the World*, *Men of Achievement*, *International Who's Who of Intellectuals and Personalities of America*. Hope our economics get better." Marguerite and **Ed Ahlberg**, Jane and **Lou Demarkles**, **R.J. Horn**, Janice Kispert, Ruth and **Norm Sebell**, and **Melissa Teixeira** met recently for dinner at the home of **Andy Corry** to deal with a crisis in our 40th Reunion plans: It now appears that Wentworth-by-the-Sea will not be ready for occupancy in June 1984. Andy Corry has agreed to be our 40th Reunion Chairman and is looking into Boston area activities for attendees staying at the Institute or area hotels. Andy would appreciate hearing from volunteers desiring to take an active role in the Reunion plans. (Write him at 34 Randlett Pk., West Newton, MA 02165.) **Lou Demarkles**, who worked on our 25th Reunion book, has already started on our 40th Reunion book. **Norm Sebell** reports that selected Alumni met recently at M.I.T. and that **Edgar P. Eaton, Jr.**, president of Carbone-Lorraine Industries Corp., has agreed to be our 40th Reunion Gift Chairman. We are already about halfway to our goal for the gift, which includes our total pledges to M.I.T. between September 1979 and June 1984 and all pledges for the next five years. If you have not yet heard from Ed regarding your gift, do not despair, for his letter will be arriving shortly.

A telephone call to the Institute noted the death of **Allan B. Porson** on May 19, 1982. Our class sympathy goes to his family and friends.—**Melissa Teixeira**, Secretary, 92 Webster Park, West Newton, MA 02165

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Would you believe that in two years we will be back in Cambridge celebrating our 40th Reunion? And it is not too early to start planning for this gala affair. Hopefully, none of us will have the sitter problems that prevailed in the fifties and sixties. One of our opportunities (a far better word than duty!) is to participate in a 40-year reunion gift, a partial repayment, if you will, of the truly inexpensive education we received. All Alumni Fund contributions of 1981-1985 make up our reunion gift. I am certain that you will be receiving reminders, details, and friendly guidance from gift chairman **Chris Boland** in the months ahead. Yes, Chris did request this unpaid announcement!

Robert L. Lohman has been at NASA headquarters for the past 15 years and with the Spacelab Program since its birth ten years ago. Spacelab is a cooperative effort with ten European countries. Its first shuttle flight is scheduled for September 1983. Wife Kate works as a systems analyst for Executive Research Association; son Rob is an architect in New York; and daughter Sally is married and living in Kingsport, Tenn. . . . In early January, **Ed Stoltz** of Englewood, Colo., updated us as follows: "I retired from Johns-Manville in September 1980, long before the present recession and the Manville bankruptcy. The business which I was managing was not considered to be in the Manville mainstream; once I found a buyer in Philadelphia, we opted for retirement in the Rockies, a good deal after 35 years. Now it is a consulting business. I'm acting as a business broker in the engineering/design arena—also commercial real estate, but no 40-50-60-hour week deals!" (The foregoing would confirm the adage—for better, for worse, but not for lunch dear!)

In mid-January the Allegheny County Medical Society gave Dr. **Howard A. Mermelstein**, a greater Pittsburgh pediatrician, its coveted Frederick M. Jacob Award as recognition of outstanding medical service. . . . **Tom Stephenson**, vice-president, construction, advises that Alcoa's business is not too good—no construction except in Brazil, which he visits every four or five months. . . . Another Phi Gam correspondent is, of course, **Jerry (the Texan) Patterson**. (And your secretary always chuckles as he thinks about that East End Avenue boy from Manhattan in his boots and 10-gallon hat.) He must be so attired to keep pace with wife Libby who manages a stable of 13 horses and ponies at Pecan Plantation. Jerry continues in the steel business but is liking it less and less as he commutes daily to Dallas. Jerry's daughter Liz married last spring. She and husband Dave are both with Intel, Portland, Ore. Lawyer Tony, wife, and three children are living in Dallas. Mark and Donna with their two live in greater Rochester, N.Y. Son Rob is in New York City scratching out an existence as a free-lance writer on the music scene. Would you care to guess which son is most like dad?!?

George Bickford indicates that he avoided Carrier's '82 Golden Handshake and is now corporate director of distribution engineering. George and Betty continue to play lots of tennis and ski as often as the snow permits. . . . In earlier notes we reported the wedding of Nina Strnad (daughter of **J.J. Strnad**) to Tracy Putnam; I now can state that the wedding picture of all seven Strnads was outstanding only to be exceeded by Edna Strnad's note. Nina and Tracy are at Washington University in St. Louis, where he is in the M.B.A. program and she is pursuing a Ph.D. in biomedicine. Other daughter Lyse and husband are M.D.s living on a farm in Iowa, while Jeff, now 30, received in absentia a Ph.d. from Yale in economics in November. Jeff is a law professor at University Southern California and is now teach-

ing economics at Caltech. As for JJ, it's still Lempco, including in absentia Florida management during the winter months.

As many are aware, Fran and I do see, on occasion, Ellen and **Jim Brayton**, now safely retired in Little Compton, R.I. . . . **Tom McNamara's** wife Louise advises that she has returned to teaching as Massasoit Community College. We assume that Tom continues with Honeywell in the greater Boston area. . . . Trudy and **Max Ruehrmund** continue at General Foods in Dover, Del., with farm living on Maryland's eastern shore during the summer months.

We have a letter from Mary and **Jim Hoaglund**. Jim, as previously reported, became chairman and CEO of McQuay-Perfex, Inc. in January. None of us were aware, however, that the '82 Minnesota snows were of such depth that Jim sank to his hips while cross-country skiing last winter. On October 9, daughter Nora, who continues as a Systems Analyst for Onan, married Kent Myhrman, an engineer, scuba diver, and fine young man. Just prior to the wedding, mother and daughter went rafting on the Colorado. . . . As Jan and **Charlie Patterson** so aptly stated, good cheer, and Carol and **Nick Mumford's** note their retirement activities, including all nine grandchildren.—**Clinton H. Springer**, Secretary, Box 288, New Castle, NH 03854

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In the absence of any inputs this month, hello-o-o out there. I've reverted to browsing through the 25th Reunion booklet and matching it against the roster just to see if people are still where they used to be 12 years ago. Here's a sampling. . . . **Chuck Fisher** now lives outside Louisville, Ky.—or is it Dallas, Chuck?—where he was recently made chief executive of Reliance Universal, which makes high pressure laminates. . . . **Lou Martin** is still in York Harbor, Me. with no listed affiliation. . . . **Bob Striker** is still in Port Washington, N.Y. and has his own video consulting business, "Beavoronics" ("early brainwashing produced name"). . . . **Warren Turner** is still living in Convent Station, N.J., and working at AT&T in Basking Ridge.

John Wandrisco is still living in Latrobe, Pa., and is vice president at Latrobe Steel. . . . **Tom Wescott** is still in Attleboro, Mass., running Wescott Construction Co. What's new Tom? How's the sailing and tennis? . . . **Bob White** has moved to Crown Point, Ind., where he has his own business, presumably consulting. . . . **Tom Williams** is still living in Potomac, Md., and is in partnership with Ayers in the air conditioning business.

If I don't get any inputs for next month's column, there will be no column, so *Puhleeze* drop me a line!!—**Jim Ray**, 2520 S. Ivanhoe Pl., Denver, CO 80222

47

Four years from now we shall be gathering for our 40th Reunion. The reunion committee, headed by **Bob Horowitz**, met in February at **Claude Brenner's** for dessert and discussion. Discussion first centered on the dessert, which was delectable, but after a while it moved to dining four years hence. Plans call for a reunion weekend such as we had for our 35th, preceded by a few days in Bermuda for those who can get away for the full week. I anticipate 100 percent attendance for the weekend, perhaps 99.5 percent for the Bermuda portion. (Do your part! Don't let me down!)

Bob Creek writes, "Numerous friends and classmates are retiring these days—not me!" Bob has been elected to his 13th consecutive year as local school board president, named "Illinois school board member of the year," and "Chicago area leader" per the *Chicago Sun-Times*. His daughter was !llinois state diving champ and finalist in the nationals, and is on a "Title 9" scholarship at the University of Illinois. . . . From **John Kellett**, another non-retiree: "The high point of 1982 came on September 28 when I participated in the official opening, by Prime Minister Margaret Thatcher, of the electric power generating station in Hong Kong on which I have been working mostly full time for the past five years." . . . **Paul Cook**, formerly president, is now chairman and chief executive officer of Raychem, Menlo Park, Calif. Paul also represents the Class of '47 on the Corporation. . . . **Moshe Arens**, then Israel's ambassador to the United States (now defense minister), in a keynote address at a three-day conference in New York, described Israel as today presenting professional challenges equal to the United States and other Western countries. To quote: "We can offer, without trepidation, an opportunity to grow intellectually, professionally, and culturally within the framework of one's chosen profession and lifestyle. Israel is an exciting, growing, thriving society, offering opportunities within virtually every profession to at least equal—if not greater—proportion than any Western country."

James Haggett has established a business, "Stepping Stones," which does consulting in three areas: productivity, helping U.S. companies do business in Japan, and helping Japanese companies do business in the U.S. . . . **John Bartelt** and his bride Sheila toured England, France, and Belgium during last summer's holiday from IBM. . . . **Steffen Dieckmann** is currently development manager, Hercules Inc., Brunswick, Ga. . . . **Dick O'Donnell** and Gina have returned to the States after five years in London and have moved into a new home on the beach at Hilton Head, S.C. Dick took early retirement after 35 years with Ingersall Rand. With daughter Lisa, they took the leisurely way home from London via Sri Lanka, Bangkok, Hong Kong, and China. Lisa hopes to return to London to work. Son Bob is in law school at Oregon University. Other recent travel has included a trip to Kenya for the animal reserves and Mombassa, while Bob worked as a ski instructor in Switzerland, and a trip to Jeddah which included trying to leave at 1:00 a.m. just after the hadj. (Translation presumed not needed for all of you scholars who know about pilgrimages to Mecca.) . . . From **Carl Eyman, Jr.**: "After graduation, worked in Malden, Mass., 14 years, Puerto Rico four years, Louisiana five years, Wisconsin 12 years, now back to Louisiana for a second time. I wonder if there is time to make the big U-turn twice? I don't think I particularly want to. Massachusetts and Wisconsin winters are too cold and their taxes too high."

The thoughts and sympathy of the class are with the families of **Jack Kiefer**, Ithaca, N.Y., and **Harry Cavanagh**, Vancouver, British Columbia, who died in August.—**Virginia Grammer**, Secretary, 62 Sullivan St., Charlestown, MA 02129

48 35th Reunion

The reunion committee has completed the general planning for our 35th Reunion, which begins June 9. Responses from classmates indicated that we will have another successful reunion. Come and join us. Your October *Review* will summarize the good fun. **Norm Kreisman** is involved with the technology transfer program (instituted to comply with a law passed by Congress) in the Department of Energy (DOE). DOE labs are government owned but contractor operated by universities, university consortiums, and large industrial companies. The laboratories have a history of noteworthy technological spin-offs to the private sector, but unexploited technology remains on the shelf. There are formidable impediments to technology transfer. For example, the business acumen required to identify marketable technology, to identify logical recipients and to negotiate licensing or joint ventures simply does not exist. Before leaving the government, Norm hopes to see the labs effectively utilizing outside resources to enhance the transfer process. He suggests that advice based on experience in dealing with the present system, would get a careful and appreciative hearing from his group.

Norm's wife, Polly, is managing the direct marketing division of Garfinkels (Allied Stores). His daughter, Polly, graduated from Cornell and is a TV news broadcaster; and Jane graduated from Smith and is an artist/craftsperson.

George Keller, chairman and chief executive officer of Standard Oil of California was recently elected a director of the Boeing Co. . . . **Paul Perkins** reports that he has finally "found the way to San Jose." Paul and his wife Gigi, are both native Californians and moved to San Jose from Westport, Conn. exactly two days before the first snow fall of the season. Coming home was great, but Paul expects to do a lot of traveling in the western states as an infrared spectroscopy specialist for the Perkin-Elmer Corp. . . . **Stan Shein**, who operates Management Techniques, Inc., providing services to computer users, sent two recent newsletters. These monthly newsletters are a combination of positive suggestions to reduce costs and case histories of the poor chaps who didn't succeed in making the computer work in a cost effective manner. Stan also sells a portable computer. Expandable storage, a nine-inch screen, operating speed, and a full function keyboard allow it to operate efficiently in or out of the office. Stan has provided software for a wide range of companies, equipment, and purposes. I will be leaving (will have left by the time you read this) on March 23 for four weeks in Nepal, trekking in the Khombu Valley up to the base of the glacier at Mt. Everest.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, RI 02806

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"I have just bought the farm," said **Noel Davis**'s note. To an old veteran like me, that is the same as "kicking the bucket" or "being six feet under." So, intrigued and curious, I called Noel, and found that Noel did indeed buy a farm from his former employer, General Mills. He has an acre-sized box that is a completely controlled environment: Add seeds, water, and a million watts of light, and three weeks later you have spinach—delicious, full-leaved, and not one grain of sand! It's ideal to sell to restaurants and hotels—and soon to consumers in the Chicago area, under the Kitchen Harvest brand.

William S. Lewis is a partner in the New York engineering firm of Jaros, Baum, and Bolles. He is a manager of the Vertical Transportation and Materials Handling Department. . . . **Dave Hardin** is chairman and chief executive officer of Chicago's Market Facts, Inc. . . . **Orlien N. Becker** retired from the presidency of Pacific Technology, Inc., and since then has been busy consulting and teaching energy management controls in a community college.

Richard W. Spencer has returned to Magnavox after ten years in Massachusetts. He and Evelyn are moving into a condominium in a converted Victorian mansion.

Robert Steinhart celebrated his 30th wedding anniversary last year with a three-week trip to Israel. Living in Springfield, N.J., he is senior marketing representative for IBM. His four children are spread from Oregon to Spain. As yet, no grandchildren. . . . On the other hand, **Walter Seibert** of Teaneck, N.J., has six grandchildren. Our class's greatest grandpa, so far! Does anyone claim more? . . . **Robert Peterson** has just moved to Houston with the Exploration and Production Group of Phillips Petroleum. . . . **Jack Fogarty** is still in Columbia, Md., and still with Westinghouse. He sends this piece of political wisdom (perhaps a bit biased): "Any working person who supports Ronald Reagan this year is like a chicken who supports Colonel Sanders."—**Paul E. Weamer,** Secretary, 331 Ridge Meadow Dr., Chesterfield, MO 63017

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In March 1982, **Alan G. Bates** took early retirement from ICI Americas after almost 26 years—the last seven as vice president and general manager of the Agricultural Chemicals Division. After a one-month vacation, Alan started as president of Allelix, Inc., a new genetic engineering company in Mississauga, Ont. The goal of Allelix is to discover and develop new products for industry and agriculture through biotechnology research. Alan's wife is staying at their Delaware residence and Alan commutes on weekends. . . . **Jim Hooper** has been elected to the board of directors of the American Humanist Association, whose national headquarters are in Amherst, N.Y. . . . **Robert E. Wilson** is now retired from Exxon Corp. after 25 years of broad experience and now operates his own consulting business, specializing in manpower analysis and planning for the petroleum refining industry. . . . **Joseph D. Dannunzio** started a new construction firm in August of 1981 with his sons, Jimmy, Joe, Michael and Stephen.

Gerald A. Lessells received the Superior Varnish Co. Award and delivered the lecture "Statistical Quality Control in the Printing Ink Industry—Practical or Blue Sky?" at the 1982 National Association of Printing Ink Manufacturers Technical Conference. . . . After 20 years as a heating and air conditioning contractor and nine years teaching physics and football in a private secondary school, **Henry Sharp, Jr.**, and his wife left the smog of Los Angeles basin for beautiful Santa Barbara. Now that their passive solar house is complete, Henry has started his third career, as a financial planner. He wants you all to know—the Sharps are very kind to visitors! . . . **Helmut E. Weber** is presently director of Pennsylvania State University King of Prussia Center and professor of mechanical engineering. He is also vice president of General Power Corp. (engine development), and commander of Main Line Power Squadron. Helmut is active in the professional development boards of ASME and Rotary. . . . **Francis F. Lee**, professor of electrical engineering and computer science at M.I.T., is chairman and founder of Lexicon, Inc. He is also a director of that company.—**John T. McKenna, Jr.**, Secretary, 1 Emerson Pl., Apt. 11H, Boston, MA 02114

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Clint Seeley reports: "Son David in Rice University grad school of architecture; daughter Laurie and son Paul in Atlanta; daughter Kate in Sweden for a year as A.F.S. student. I have finally finished paving driveway with cobblestones (10,350 of them) after three and a half years of hard labor. Still the old man of an eight-doctor radiology group. Visited Joyce and **Harry Wolf** in Houston last Spring—am trying to get classmates to plan ahead to come to the 35th Reunion." . . . **John Bergmann** writes, "For the past seven years I have operated my own consulting business serving the brewing and distilling industries. I travel extensively to South America and occasionally to the Far East and Africa." . . . **William A. Krampert** has retired after 22 years of management consulting with A.T. Kearney, Inc., in Chicago and is now living the "good life" in Colorado. His "retirement" is really full-time work as director of industrial products for Mountain Medical Equipment, Inc., of Littleton, Colo.

Donald R. Galinat and wife Pat recently moved from Lancaster, Pa. to Kearney, Nebr., where he is group vice president (filter products) for J.L. Clark. The Kearney facility manufactures a complete line of oil, air, fuel, hydraulic, and coolant filters. . . . **Daniel J. Marcero** received a Dreyfus Fellowship as visiting professor at Linnfield College in Oregon. He is professor of chemistry at Syracuse University, Syracuse, N.Y. . . . **Donald L. Brown** writes, "I am starting my 23rd year with Reynolds Metals by joining Reynolds International as architect in charge of the company's international manufactured housing activities. Our most successful project to date is in Trinidad."

William J. Cavanaugh recently was awarded the C. Paul Boner Medal for outstanding contributions to the acoustical consulting profession by the National Council for Acoustical Consultants. . . . **Tom Kelly** was honored this December as Greater Gardner's 1982 Citizen of the Year for his significant contributions to the welfare of the community through his involvement and participation during the past 25 years. Tom is president of Lilly Industrial Coatings in Templeton, Mass. He has served as president of the board of trustees at Henry Heywood Memorial Hospital, was a director of the Gardner Cooperative Bank, helped organize the Sacred Heart Parish Council and served as its first president, serves on the executive committee of the Monadnock Council, Boy Scouts of America, and serves on the Greater Gardner Chamber of Commerce.—**Gregor J. Gentleman**, Secretary, 818 Southwest Ninth St., Des Moines, IA 50309

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With any luck, spring will see fulfillment of winter's dreams, and even as you read this, **James Stolley** should be carrying out his. He writes, "In May and June, a few friends and I plan to sail a 57-foot ketch across the Atlantic. We will be following the route that William Buckley describes in his two books, *Airborne* and *Atlantic High*: starting from St. Thomas in the Virgin Islands, a thousand miles north to Bermuda, then 1800 miles east to the Azores, and then a 900-mile leg through the Straits of Gibraltar. I am currently struggling with celestial navigation, which is a little less baffling than freshman calculus but not much. My wife will wander around Europe for the month that I am at sea. Our trip is not unique—hundreds of people do it every year, and we are certainly not out to prove anything other than that the Atlantic can be sailed in a comfortable and enjoyable manner. No 12-foot dinghies or single handed sailing for us! I do intend, however, to make my annual offering to the Alumni Association before I leave so that in the event the Bermuda Triangle swallows us, M.I.T. will not suffer."

Howard Fawcett lets us know that he is "very much enjoying the challenge of my new position with Lockheed Shipbuilding and the great Pacific Northwest." . . . **John Small** joined International Development Corp. last November as chief geologist, working out of London. . . . **Robert Norton** is a chartered financial consultant with Norton Financial Consultants in Holliston, Mass.

Nicholas Haritatos writes, "Last year I worked on a phosphate project, an Aramco amine plant, and the fructose project with Cetus. The fructose project was extremely exciting and challenging, but Chevron has withdrawn from it. I am now coordinating a project based on Utah tar sands. We also added a bedroom to our house for my mother-in-law. Adding a room to a house on a steep hillside lot can be frustrating and challenging." . . . **Stanley Gelles** runs a metallurgical research and development consulting firm in Columbus, Ohio, and is doing research on gravitational effects in materials processing. Space shuttle experiments are anticipated for this spring. His wife, Rhoda, coordinates a program for academically talented youngsters in the local school system. His son, Jeff, is a graduate student of biochemistry at Caltech. A daughter, Lisa, works at Massachusetts General Hospital, and his youngest child, Ellen, is in high school.

We are sorry to report that **Keith R. Johnson**, of Minneapolis, died August 10, 1982.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

53 30th Reunion

A recent note from **Marty Wohl** provides the following information on Alumni Fund giving by our class. He points out that in 30 years since graduation 593 of 783 class members have donated $466,690 or approximately $27 per giver. However, 20 percent was given by two classmates, 50 percent by ten classmates, and almost 70 percent by 59 classmates. In short, 10 percent of the givers have contributed 70 percent of the donations. Looked at another way, 30 percent of the givers contributed less than $100 in 30 years, 76 percent less than $500, 90 percent less than $1,000 and 96.6 percent less than $2,500. This computes to $12 per year, on the average, for all but a very few. If you think of the after-tax level of gifts, this is "mind bogglingly low," says Marty.

I believe that everyone is aware that the actual outlay by the student has, over the years, represented less than half the cost of the four years. It would seem that we, who have benefitted so greatly from the education and reputation of M.I.T., could each afford to do more to help those who will follow. Think about the statistics Marty provided, and when you receive your gift solicitation, try hard to increase your gift if you have been giving. And for those who have not, how about a new start? On the lighter side. **Bob Fahey** was elected vice-president and corporate secretary of the Penn Central Corp. . . . **Theodore Taylor, Jr.** is currently senior executive staff member of Corpate-Tech Planning where he is responsible for government technology and cost assessment programs. . . . **John F. Becker** has been promoted to manager of flat rolling practice and development in the steel operations department of Bethlehem Steel Corp. . . . **Carl I. Swanson** has been named director of quality assurance for Fenwal Inc. . . . **Al Danzberger** has joined the Denver office of Dames and Moore as a consultant.

Just to prove that those blurbs you send in with your Alumni Fund contributions do get to me, let me include a few. **Jean Pierre Radley** is president, Frigere, Inc. . . . **Hans Van Gelder** works for the air force and is on loan to NATO working in communications. . . . **William T. Lincoln** was recently promoted to director of engineering for National Public Radio. . . . **Allan Hoffman** is professor of chemical engineering and bioengineering at the University of Washington in Seattle. . . . **Al Switendick** is on temporary assignment from Sandia Laboratories, Albuquerque, N.M., to the Division of Materials Science, Office of Basic Energy Research, U.S. Department of Energy.

And, on even a lighter side, **Ed McCluskey** reports that he won a disco dance prize in Edinburgh in April 1982. How's that for a close? One final comment. I hope I see you all at the reunion. I'm planning to catch up on all the news while there.—**Gil Gardner**, Secretary, 3400 Rusticway Ln., Falls Church, VA 22044

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Some people just never know when to quit. **Stan Hoff** is much too old to be going to school, but he recently received a master's degree in industrial engineering. He is now working with Singer Kearfott in Little Falls, N.J. His daughter Elizabeth married David Walsh last year. His daughter Susan is a senior at Rochester Institute of Technology. Stan also has three sons, Andrew, Ben, and Paul, all of whom are gainfully employed (which is no small thing these days). . . . **Lou Mahoney**'s son Jim, a chemical engineer who works for Arco in Philadelphia, is due to get married in June. Lou's daughter Chris (a mechanical engineer) and her husband both work for GE in Pittsfield, Mass. . . . It's a pleasure to report that Peggy Brown, one of Connie and **Jim Brown**'s four gorgeous daughters, is now Mrs. Michael Arrington. Jim and Connie also have two handsome sons. Jim, Jr. is a freshman at Georgetown University, while Joe (the last at home) plays soccer for his high school team.

Dave Trumper left Hewlett-Packard to go back to graduate school. Guess where? He claims that being back at M.I.T. is a lot harder than work.

Anyone out there believe that? . . . **Bill Zoino** and **Don Goldberg** who are teamed up at Goldberg-Zoino and Associates (a geotechnical engineering firm in Newton, Mass.) recently started a new company, GZA Drilling. They provide test boring and related services to measure soil, rock, and groundwater properties.—Secretaries: **William Combs**, 120 West Newton St., Boston, MA 02118; **John Kiley**, 7 Kensington Rd., Woburn, MA 01801; **Louis Mahoney**, 52 Symor Dr., Convent Station, NJ 07961; **Dominick A. Sama**, 28 Chestnut Hill Rd., Groton, MA 01450

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Life is tough. Some of you who lie about in daisy patches thinking of new ways to use guava probably aren't aware of it, but it's true. The choice of an engineering career puts one on a bridge between reality and the future, with a keen appreciation of the condition of the trusswork. But I digress.

John Dixon writes he has completed 11 years as the editor of *Progressive Architecture* magazine. He finds them good years—the magazine has done well. The children of John and Carol are Ivy League—Peter graduated from Harvard this year, and Susannah is a sophomore at Princeton. Carol is chairman of the history department at Greenwich Academy, a private school for girls. John says that tuition bills dominate the family economy. Well, that's not exactly news, John; Cornelius Vanderbilt would send his kids to a state school today. . . . **Ashton (Asa) Stocker** sends a note bringing me up to date on his activities. (By the way, it would be nice if you did too. The last report I got was when the tire on your rototiller went flat as you drove over your former dorm roommate at the 5th Reunion.) Asa remarried four years ago, and he and Martha are now the parents of Elizabeth Margery Stocker. He enjoys his work as a division manager of M/A-Com in Waltham, Mass. The company has fared well, and so has Asa. . . . **Ella Paton Gardner** is an assistant professor in the decision sciences department of George Mason University in Fairfax, Va., and lives with her two children (Andrea, a high school senior, and Paul, a freshman) next to Great Falls Park in McLean. **John Farmer** won a seat in the Vermont legislature last year. John received some good press, being cited as an independent businessman, former secretary of the state agency of development and community affairs, pro-business, somewhat liberal, and an advocate of local control. John called for diminishing the dependence on the property tax and encouraging businesses to locate in Vermont. We could use him locally, where the periodic cry for more taxes is beginning again. . . . **Paul Goldan** has had a series of distinguished accomplishments at the Aeronomy Lab of the Department of Commerce in Boulder, Colo., where he conducts research on the chemistry of trace atmospheric constituents. Last year he received the Distinguished Research Paper of the Year Award, and in 1965 he was a Gold Medal recipient for an outstanding research paper. In 1978-79 Paul was an exchange scientist in West Germany, working in atmospheric chemical detection techniques.

The M.I.T. Alumni Officers' Conference last fall in San Francisco was a hit with **Joseph Carleton**. He is working for Eaton Corp. in silicon valley, and also teaches auto mechanics in adult education classes. Joe was elected to the executive committee of the local Sierra Club chapter, and spends what is left of his time with photography, hiking, and camping.. . . Exxon Research and Engineering Co. has ended its laser isotope separation research program, where **Philip Eisner** was a project manager. He has been transferred to an engineering lab and is now a senior staff advisor in research planning. Phil reports that his wife Betsy and 13-year-old son Ned are fine, and I assume he is, too. **Manmohan (Mani) Pathak** has been appointed corporate director of planninng and acquisitions for Foster Wheeler Corp., an international engineering, manufacturing, and construction organization. He joined Foster Wheeler in 1979 as a manager and became director of long-range planning a year later. Formerly he had been a project manager with Bechtel, chairman of Engineers India Ltd., and a member of India's Planning Commission. He and his wife Rita, a credit consultant with Dun and Bradstreet, are the parents of three children and reside in Chatham, N.J. . . . And, as a final kudo, I'll cite the increase in responsibility last year of **Richard DiBona**. Dick has assumed the duties of chief executive officer as well as those of president of Microwave Associates in Burlington, Mass. Send news.—Co-secretaries: **Marc S. Gross**, Winding Road Farm, Ardsley, NY 10502; **Allan C. Schell**, 19 Wedgemere Ave., Winchester, MA 01890

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A clipping from the Brockton, Mass., *Enterprise* reports that **Edward Atkinson** was guest minister at the Brockton Universalist-Unitarian Church. Ed holds a degree in architecture from M.I.T. and a bachelor of divinity degree from Crane Theological School, Tufts University. He served as an officer in the U.S. Navy and now is minister of the First Parish Unitarian Church in Cohasset, Mass. . . . **Michael Schmid** writes: "My wife, Mary, and our family (Beth, 17, Susan, 15, and Robbie, 12) moved to Reston, Va., from Wheeling, W. Va., four years ago. I am now an independent consultant providing support in the planning, start-up, and operation of new processes and plants, as well as process and process equipment reliability and availability. . . . From California, **John Crews** writes that he is currently co-owner (with Bill Bechtold, '64) of Apple Computer Stores in Millbrae and Palo Alto—"Peninsula Computer." . . . **Robert Holton** writes: "I joined the Organic Chemical Division of W.R. Grace in October, 1981, and am director of manufacturing for engineering nitroparaffins. We are currently designing a first-of-a-kind plant with Stone and Webster Engineering Corp. in New York City and have started construction at Deer Park, Tex. My involvement is now shifting towards the areas of construction and staffing for operations that are now expected in early 1984. With one son in college and a boy and girl in high school, we'll delay relocation until June 1983."

I am sorry to report the death of **Jim Cunningham** on January 14, 1983. He is survived by his wife, Anne, and daughters, Amy and Susan, 4144 San Carlos Dr., Dallas, Tex. Anne writes, "Jim battled leukemia for four-and-a-half years; most of that time he was able to lead a normal life, and he thoroughly enjoyed visiting with old friends at the 25th Reunion. His family is currently working to establish a scholarship fund at M.I.T. in his honor to which his classmates may contribute if they wish. I will send details later. At the time of his death he was playing a "long shot" in the form of a bone marrow transplant at Barnes Hospital in St. Louis."—**Vivian Warren**, Secretary, 156 Northrop Rd., Woodbridge, CT 06525

58 25th Reunion

Three, two, one, zero . . . We have lift-off for the Reunion! Our first orbit begins on Thursday evening with a buffet dinner alfresco in the courtyard of 500 Memorial Dr., followed by the *Star Wars* music of Boston Pops director John Williams and post-Pops cocktail party. Friday is Technology Day with a reception at the President's House, then on to dinner and dancing 'till the wee hours. On Saturday morning, it's sports time with a Fun Run, softball, tennis, and volleyball on the campus that ought to work up your appetite for the afternoon clambake. Our reunion spaceship has two excursion modules—one for the Vineyard and one for Boston. The Vineyard vehicle leaves about 4:00 p.m. for the trip to Wood's Hole and the Island for two days of fun. Meanwhile, those in the Boston module will be orbiting the city and exploring the landmarks that have sprung up since their last visit. All in all, a great reunion event for everyone. If you haven't already signed up, do it now—it's never too late.

At the University of California, San Diego, **Tom Bond**, a member of the Department of Chemistry faculty for the past 15 years, was recognized for his excellence in teaching. The award commended Tom for his extraordinary effort outside the classroom and for his concern for the well-being of his students. . . . A note in this month's mailbag comes from **Steve Corman** bringing us up to date on his latest move at a company famous for moving: "In September, 1982, I transferred from IBM's Systems Center in Gaithersburg, Md., to an assignment at divisional headquarters in White Plains. My new position is that of senior product administrator, which includes the task of bringing new products from the development divisions to the marketplace. My wife, Betsy, and I have bought a large contemporary home in North Stamford, Conn. This brings us more than halfway back to home and M.I.T., and to the Reunion."

Because this month's notes are always written just as the friendly tax man is making his rounds, the mail is always a little light this time of of year. By the time you read this column, however, it will be nearly time to pack your bag for the 25th Reunion. Everyone on the reunion committee looks forward to seeing you there. **Martin O'Donnell** and the committee members have done an outstanding job in putting together a fun-filled weekend of activities. A big vote of thanks in advance for their efforts. Come on down and enjoy the fun!—**Michael E. Brose**, Secretary, 59 Rutland Sq., Boston, MA 02118

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Sy Rubenstein is now vice-president and general manager of the Shuttle Orbiter Division, Rockwell International, moving up from program manager of the Space Shuttle Orbiter Development Program. Sy reports that **Shelley Razin**'s company, Quality Systems, has gone public. Shelley is the founder, chief executive officer, and chairman of the board of his company. . . . **Oscar Snyder** is organizing a company called Hospitality Institute of Technology and Management to educate industry in the use of technology and modern management principles. He hopes to prove that such education does not need government funding but can be accomplished through industry gifts, scholarships, research grants and consulting. . . . A news clipping indicates that **John Dowd** is in the process of computerizing the freshman physics labs at Southern Massachusetts University. At last, someone may have arrived at a method to eliminate all of those tedious calculations and measurements. . . . **Bill Butcher** is still traveling as regional manager for Suburban Propane. Bill's two daughters are both in college, one in Pennsylvania and the other in Springfield.

After ten years as chief executive officer of Precision Monolithics, Inc., **Earl Rogers** is starting his own consulting firm specializing in long-range planning, organizational development, and marketing strategies. . . . A note from **Robert E. Hillman** indicates that he is a member of the patent law firm of Fish & Richardson in Boston. Bob does not say whether his membership in that firm is recent or is of long standing. . . . **George Yerid** writes that he is practicing as an orthopedic surgeon in the Chelmsford-Lowell, Mass., area. . . . **Wilbur Lattimer** says that he is still with Asarco in downtown New York City.

Those of you who failed to take me up on the offer to meet me skiing at Killington in February missed out on a great week. The weather was most un-Killingtonlike: the sun shone almost every day and I even got a tan.—**George L. Barnett**, Acting Secretary, 90 Broad St., New York, NY 10004

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The architects among us have constructed an enviable edifice of accomplishment. **Richard Jay Bertman** has been elected chairman of The Back Bay Architectural District Commission, which is charged with maintaining the architectural integrity of Boston's Back Bay area with its many outstanding examples of Victorian architecture. Richard also serves on the board of directors of the Boston Architectural Center and the Boston Society of Architects. . . . **Howard A. Patterson** has been elected vice-president of the Connecticut Society of Architects/American Institute of Architects. He will automatically succeed to the presidency in 1984.

Richard H. Oeler was named vice-president and general manager, business divisions for the process systems group of Air Products and Chemicals, Inc. The divisions produce and market tonnage industrial gases, process equipment, and Houdry process technology and catalysts. Says Dick "I'm enjoying this new challenge very much." . . . **Ron Novak** writes, "I would like to say hello to the disassociated class members of '60. I'm also guilty as this is the first note I've put on the pledge card in 22 years. I'm running a mechanical construction business in the New York City area, working on a few of the larger buildings, including the new convention center. I would love to hear from any classmates who may come upon this note." You can reach Ron at Novak and Co., Inc., 858 East 29th St., Brooklyn, NY 11210, (212) 258-9500. . . . **Brian V. Mokler** says, "I've just started my own consulting business, small particle technology. I will be involved with the general field of aerosols and their use and effects in inhalation toxicology, industrial hygiene, and air pollution control."

Robert E. Stenson tells us that he has gone from electrical engineering to medicine, specifically cardiology. "I did my medical training at Harvard and then participated in the post-graduate cardiac program at Stanford. During my stay at Stanford I was involved in designing computer software for the heart catheterization laboratory and the coronary care unit in conjunction with Hewlett Packard. Tiring of the academic role, I turned to private practice in 1973 and now am director of cardiology at Good Samaritan Hospital in Los Angeles. . . . Also on the west coast, **Stephen I. Cohen** writes that he is now president of Centipede Computer Systems, Inc., of San Francisco, specializing in computer data processing consulting.

As we head back east, **Donald S. Sipos** writes that he has been in Houston with SGL Piping Systems for the last two years. His son, Peter, is architectural engineer (structural) with Walter P. Moore and Associates in Houston; his daughter, Pam, is a legal secretary in the Houston office of Columbia Gas; and his wife, Cynthia, is "very active in church work, motherly, and grandmotherly functions." . . . **Howard L. Gendel** says that he is head of a marketing research firm under his name—Gendel Marketing Research Co. His daughter, Elaine, is a freshman at Emory University, and his son, Mitchell, is a senior at Jericho High School. . . . Meanwhile, back in New England, **Roger D. Hohman** tells us he retired from the Army Corp of Engineers in 1980 and is presently senior facilities engineer for Digital Equipment Corp. in Northboro, Mass. He is active in church, Boy Scouts (local vice-chairman), and Rotary Club and is married with two sons in college and one daughter. . . . **Gerald J. Hornik** is chairman, Hollis School Board, Hollis, N.H.; director on the board of trustees of the Nashua (N.H.) Symphony Orchestra, and a board member of the Corporate Council on Critical Skills.

How about some more of you "disassociated" class members, to use **Ron Novak**'s term, who've been mum for 22 years, telling us where you are and what you're doing!—**Noel S. Bartlett**, Secretary, 15320 Edolyn Ave., Cleveland, OH 44111

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It seems that everyone in the class is associated with computers in some way or other. My secretary has forgotten how to use a typewriter, and all of our lab files are kept on a Digital Equipment Corp. VAX. A couple of months ago I was chatting with **Tom Hastings**, who works for Digital, and I mentioned how fine a machine the VAX was. He answered that he thought so too, since he had designed it. The computer hackers who run the VAX are suitably impressed to hear that I used to program on the world's first transistorized computer, the TX-0, back at M.I.T. They feel as though they are talking to history! But the computer in the lab wasn't enough for me so I went out and bought a little Osborne computer. Recently I put the results from our 20th year questionnaire into a data base and hope to work out some correlations: Are fraternity men happier than dorm rats?

Maynard Johnson writes that he has started using an Apple 2/ in his office. He says, "I never thought I would get addicted to using computers but having one in my office is not only useful but fantastic fun. I have been in Cincinnati as staff counsel in the patent department at Merell Pharmaceuticals since 1981." . . . **Dan Kennedy** is also into computers—from the software end. In April 1982 he started a new company in Cambridge called Texet Corp. It was his third start-up. Texet develops, manufactures and markets text processing systems for book and technical publishers. . . . **Bob Creasy** writes that he is still at the IBM Scientific Center in Palo Alto, and that he enjoys "the accelerating pace of the computer field." The Creasys have seen both of their children off to college and are getting accustomed to living alone. Rosalind Creasy has used the free time to write *The Complete Book of Edible Landscaping*, which was published last spring by the Sierra Club. . . . **Irwin Sobel** writes, "I am leaving Columbia University after nine years of academic research, to join a group doing industrial automation at Hewlett-Packard Research. My family, including wife Cheevah and 4-year-old daughter Sarah, all moved from New York to Palo Alto where Cheevah and I met 13 years ago." . . . **Phil Robinson** is also into high tech. He writes: "I recently took on a new responsibility as vice president/general manager of Tektronix's Instrument Systems Division, a provider of laboratory oscilloscopes, instruments and digital signal processing systems. Also, I am heavily involved in a local effort to improve the quality and quantity of engineering and science college education in Oregon." . . . **Ken Singer** is also in Oregon, practicing orthopedic surgery in Eugene, where he specializes in sports medicine and knee surgery. He writes that he enjoys life in the Northwest.

A recent note from **Cam Ross** reports that all is well with his family and informs us that **Jon Bradley** has started his own computer company. . . . Betsy and **Dan McConnel** are living in Fairfield, Conn., where Dan is president of Machlett Labs, a subsidiary of Raytheon, working in the medical X-ray field. He mentions that since moving from Iowa he has high hopes that friends passing through Fairfield will give him a call. . . . **Bill Burns** writes that he is laboratory director of the Chemical Sciences Lab at Exxon in Linden, N.J. . . . **John Castle** and I spoke on the phone a couple of months ago, while he was trying to get me to cough up a little money for M.I.T., and he mentioned that he had joined one of the Boston area's new biotechnology companies, called Seragen. It sells a whole line of exotic medical research reagents, and supports research in new drugs and delivery systems. . . . **Don Easson** writes: "We have been in Greenville, S.C. for the past six years. I am division manager, process and environmental engineering, for Daniel Engineering. Both of our children are attending the University of South Carolina. Dave graduates in chemical engineering this spring, and Kim is a freshman." . . . **Charles George** reports that he is the president and treasurer of G & S Constructors in Meredith, N.H.

Congratulations to **Sue Kannenberg**, who received the Harold Lobdell Distinguished Service Award from the M.I.T. Alumnae Association last June. . . . Congratulations are also in order for **Mike Wechsler**, who won the Albert Einstein College of Medicine Humanitarian Award last fall. Mike is senior vice president of the Chemical Bank in New York City and is the head of its real estate division. . . . **Bob Glass** is in tinsel town, recording sound for the movies. Among his credits are Academy Award Nominations for "The Exorcist," "A Star Is Born," "Close Encounters of the Third Kind," "Hooper" and "1941." He should probably win an Oscar for his most recent work: "E.T." . . . A note from **Ray Johnson**: "I recently transferred to a new job as consultant on structural systems development for the Connecticut operations of CIGNA Corp. I am also president of Otis Campsite Construction Corp., which is building a camping condominium in the Massachusetts Berkshires. In addition I'm president of Griffin Park Toastmasters of Windsor, Conn. Elaine and I are Marriage Encounter coordinators for the Farmington Valley and are conducting workshops for engaged couples for the Hartford Diocese."

There was an interesting article in the *Washington Post* last November by **Richard Berendzen**, president of American University in D.C. in which he recalled two formative incidents from his days at M.I.T. The first of these was the time he couldn't get books required for a paper because classmates had checked them out of the M.I.T. and Boston libraries. When he found that they were at Harvard, he was frustrated by regulations and an early closing of the library. The professor was not at all sympathetic and gave the incomplete paper an F, saying that effort doesn't count—only success. The other incident occurred on Dick's first day at the 'Tute. Trying to look important, he marched into a room with an imposing door—only to find that it was a janitor's closet. Embarrassed, he stayed inside for quite a while until he gathered enough courage to re-enter the corridor. The lessons: Humility and Don't Enter Unmarked Doors.—**Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, MA 02167

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Elliott Bagley writes that he and his business Whirl Wind Power Co., manufacturers of wind-powered electric generators, are now in Duluth, Minn. . . . **Barry Belkin** has been promoted to technical director of the Paoli, Pa., office of Daniel H. Wagner, Associates, a consulting firm in operations research and mathematics. . . . **Keith Ferguson** got married last summer. His wife Margaret is a speech therapist who did graduate work at Smith College. They met through square dancing, which they still enjoy. Keith continues to be a project manager for Hewlett-Packard in Santa Clara, Calif. . . . **Edward Feustel** is still at Prime Computer in Framingham. His wife De is now at Tufts New England Medical Center as an R.N. in the neurology department. They now have a house in Sherborn. . . . **Arthur Funkhouser** recently completed training at the C.G. Jung Institute in Zurich and is starting a practice in Bern. He also does computer programming and translation work. His wife Meret is Swiss and they have two children, David, 5, and Evelyn, 2. Tennis, ping-pong, and skiing are his hobbies. . . . **Jeremy Goldberg** is now responsible for the management of life cycle maintenance for the Navy's PHM class hydrofoil ships. His wife Marcia is director of a consumer oriented organization. His son Eliot's bar mitzvah was last December and his daughter Devra's will be in September 1984.

Robert Heinmiller is vice-president of Omnet, Inc., a Boston communications consulting firm. They have created a new electronic mail network for the international research and development community called SCIENCEnet. . . . **Dave Ljungquist** joined American Can a year ago as associate director of future business development

in the plastic packaging sector. His wife Carol is still teaching fifth grade in Bethel, Conn. Their daughter Debbie will start college this fall and their son Pete is in high school. . . . **Thomas Morgenstern**, M.D., practices orthodontics in a partnership with offices in three New Jersey towns. His wife Judith is area coordinator for an aerobic dancing program. . . . A news-clipping from a Rutland, Vt., paper contains a letter from **Alan Regier**. He and his wife Wendy have developed a science enrichment program for their local school in Cavendish, which they are trying to get the school board to fund. . . . **John Rollwagen**, in addition to being chairman, president, and chief executive officer of Cray Research, Inc., is now also director of Northwestern National Bank of Minneapolis.

Don Shakow was promoted to associate professor of economics at Clark University in Worcester. He is director of the regional development unit in Clark's Center for Technology, Environment, and Development. . . . **Stephen Smith** left the academic world three years ago to become director of research and engineering at EMR Photoelectric outside Princeton. The company designs and manufactures photo-multiplier tubes used in nuclear measurements for oil well logging and space astronomy. . . . **Kenneth Wang** is currently working on a new type of textile spinning process which has the potential of increasing productivity tenfold.—**John Prussing**, Secretary, 2106 Grange Dr., Urbana, IL 61801

63 20th Reunion

Well folks, I guess this is my swan song. I have enjoyed doing this column for the past ten years, and I am ready to pass my quill along to one of you. I have had some volunteers for the post of class secretary, and I am sure that '63 will be well represented in these pages over the next decade. I will enjoy reading about you as much as I enjoyed writing about you.

One final commercial for our 20th Reunion. It will be held over the weekend of June 10-12, so reserve the date. All of us have a friend or two we haven't seen since leaving the Institute. Why not track down that friend and see him/her at the reunion. Drop me a line or give me a call and I'll see if I can help with the detective work. I'd like to see a good turnout at this, our 20th. And now, the news.

Henry Nau writes that he continues to enjoy his work at the White House on the National Security Council. He did a lot of traveling this past fall—to London, Bonn, and Paris in October, and Geneva for the GATT Ministerial Conference in November, then back to Paris and Brussels in December. Henry says it sounds glamorous but to survive you must learn to sleep sitting up. . . . **John Brach** sends greetings from Atlanta. When John is not directing the design and construction of Atlanta's transit system, he enjoys tennis and raquetball. He has also started cycling with his 13-year-old son, Brian. John has stayed within five pounds of his weight at graduation and wonders how many of us can claim that? (I certainly can't, but I was too skinny then, anyway) . . . **Thomas Goldberger** reports that he is president of the recently formed "Asociacion M.I.T. de Venezuela" (M.I.T. Club). Thomas and Luis Jose Odon '62, are principal partners in a mechanical project and contracting company. Thomas is married and has two sons.

Ron Alpert as assistant manager of basic research at Factory Mutual Research in Norwood, Mass., has spent the past 14 years in research on industrial, residential, and aircraft cabin fires. Ron's wife, Judy, is an accomplished ceramicist, giving lessons on clay sculpture and wheel throwing to children and adults. The Alpert's home basement has become a pottery studio. Ron's daughter, Audrey, 9, is a flutist, ballerina, and tap dancer, while her sister, Alexis, is a 5-year-old gymnast. Ron also reports that he has enjoyed his involvement with prospective students as an M.I.T. educational counselor. . . . **Toby Zidle** sent a newsy note, updating us on his activities over the last five years. In 1978 he was a senior geophysicist with Geophysical Analysis and Processing Group of Arco Oil and Gas in Plano, Tex. In the fall of 1978 he transferred to the exploration staff of Arco International in Los Angeles, where he was involved with activities in Australia, Indonesia, and the People's Republic of China. In November 1979 he led a technical group for discussion in Beijing, and in December of that year he became technical coordinator, geophysics, for Arco International Oil and Gas. In 1980 Toby moved to Norway as geophysical representative for Arco Norway, in charge of the development of a seismic processing computer system. He took his present position of exploration coordinator for Arco Norway in April 1982, and he now manages an exploration staff dedicated to Arco's Norwegian petroleum exploration efforts. Sound like a busy five years!

Mark Grebler reports that he and his wife Marilyn had a visit from Marily and Harry Movitz, '65, last fall. Harry recently completed a murder mystery novel with a plot that involves the Apollo program. . . . That's all there is, there ain't no more. Keep those cards and letter coming in . . . to your new class secretary. See you at the reunion.—**Mike Bertin**, Secretary, 18022 Gillman St., Irvine, CA 92715

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We are just back from a week's winter vacation on St. John in the U.S. Virgin Islands. Anne and I took the kids down for the Washington's Birthday school vacation that puts everyone with school-age kids from Massachusetts in a sort of winter vacation lockstep.

The *Review* held over my February/March column for April due to space constraints, so we have quite a bit of material by recent standards. . . . **George McQuilken** left IBM in 1981 to found Spartacus Computers in Bedford, Mass. He assembled a team who have now developed a distributed processor that is program-compatible with IBM mainframes, and the company plans to manufacture and sell these systems this year. George expressed an interest in hearing from classmates who are interested in joining a high-potential company in its early stages. . . . **Bruce Morrison**, a Democrat, is the new U.S. representative from the Connecticut third congressional district. Prior to his campaign, Bruce had been director of New Haven Legal Assistance. . . . **Bill Pike**'s first book *Why Stocks Go Up (and Down)* was published in January, and he encourages us all to buy a copy. . . . **Jim Hester**, who spent a while running the M.I.T. Alumni Association, has returned to academia and is teaching in the graduate program in health administration at the University of Lowell, Mass. He reports that the twins are now five and are enrolled in the Waldorf School in Lexington. . . . **Barry Smernoff** has closed his consulting firm and taken a position as a senior fellow at the National Defense University, which he characterizes as "Secretary Weinberger's think tank." Barbara closed her thriving dance studio, and the family (including Jeffrey, 12, and Michelle, 15) has moved from Westchester County to Fairfax County. Barry traded a five-minute for an hour commute to attack the middle ground of realistic defense postures, with emphasis on advanced technology.

Barry Wessler, after nine years with Telenet, has started a new company, NetExpress. Barry and Marilyn are still in the Washington area with son Michael and daughter Emily. . . . **Art Buskin**'s year-old consulting firm, Telemation Associates, continues to grow. The firm is doing work in international communications, trade, and high technology. Kathy is policy director for Senator Gary Hart, who will have announced for president by the time you read this column. . . . **Alan Schutz** has moved to Geophysical Survey systems in Hudson, N.H., as director of engineering. Alan says the firm makes a ground probing radar system that uses a carrier-free radar and was employed to locate the wreckage and bodies that resulted from last winter's crash of an Air Florida jet into the Potomac. Alan and Berylee have four children, and Alan says that helping raise David, 4, and Shayleen, 2, is a special joy. . . . **Dave Rubin** says that he has become an expert on accident statistics in the last year, as he has prepared the reports on the National Accident Sampling System and the Fatal Accident Reporting System. Dave and Sharon were planning (when he wrote) a trip to Australia, Japan, and Hong Kong, with the Kellogg Foundation paying Sharon's way. Dave says the kids are now in rampant adolescence.

Bob Morgan received his M.B.A. from Pace University last year and joined ITT as manager of communications for the company's Advanced Technology Center (ATC). Bob says the ATC is a corporate research facility in bucolic Shelton, Conn., which does work in telecommunications, LSI circuits, and computer science. He says that there are a fair number of other alumni there. . . . **Ed Hoffer**'s note from around the corner says that Ed is still in private practice in Framingham, Mass., and winding down after five years as medical director of the Massachusetts Emergency Medical Services Office. Ed is also a volunteer medical adviser to the local hospice program. Son Jed, 12, is at the Fessenden School and an avid hockey player, and Scott, 4, wants to do everything his brother does. Pam is active in the Wellesley Scholarship Foundation and junior sailing program. . . . Diane and **Dick Schmalensee** still live in Brookline, Mass. Dick is at the Sloan School, so Anne and I see them occasionally at school and social functions. The Schmalensee's had a second child, Nicholas, in June 1982.

Chris Ebbe is still in charge of psychology intern training for the San Bernardino County Department of Mental Health. . . . **Bruce French** is a group engineer for Martin Marietta in Denver, Colo., and is doing mission analysis for Titan III launch vehicles. Bruce reports that his wife, Sue, died in June 1981, and that his 3-year-old son, Andy, is the joy of his life. Bruce would like to hear from classmates. . . . **Bill Brody** was recently promoted to professor of radiology and electrical engineering at Stanford. He is working on the development of digital radiographic techniques for the detection of cardiovascular disease. Bill and Wendy live in Palo Alto with their children ages 8 and 2.

Scot Duncan is still a vice-president with Booz Allen and Hamilton's Technology Management Division in Cleveland, Ohio. However, he says that he has expanded his interests to retailing since his wife, Darla, opened an intimate apparel shop, Duncan's. They hope to have three stores and a catalog operation within three years. . . . **Steve Roth** is teaching physics at John Jay College in Manhattan. Steve and Margaret and their two daughters live in Manhattan. . . . **Henry Weil** is managing director of Pugh-Roberts Associates in Cambridge. The firm specializes in the application of system dynamic modeling to corporate strategy problems. . . . **Ed Bucher** is working on EHF satellite communications at Lincoln Lab. Ed and Gail have two children, Sabina, 6, and Eric 3.

Now that is more like it. If you folks will send in more fund envelopes or just write, maybe we can have a decent column every month.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA

66

"Your pleas for news from classmates have been so pitious that I couldn't help responding," writes **John Dawson**. He and his wife, Cheryl Klitzke, '67, are working on a project at the Institute for Advanced Study (IAS) at Princeton. John is one of the editors of a translation of Kurt Godel's works for the Association of Symbolic Logic, while Cheryl is helping to decipher the mathematician's notes, which are written in a form of shorthand no longer in use. They both continue to play the flute.

You can contact them at IAS, Princeton, NJ 08540. . . . **Tom McDonough**, a science fiction writer of some note, gave a talk to the Author's Club of Hollywood entitled "E.T.: Phone Earth!" He is still teaching at Caltech and is coordinator of the search for extraterrestrial intelligence at the Carl Sagan Planetary Society. . . . **Tom Grover** writes that he has taken a new job with Valley Lab as manager of the electro surgery group in Boulder, Colo. He claims the terrain there is perfect for noontime bicycle riding.

Damian Kulash has joined the National Academy of Sciences Transportation Research Board as assistant director. . . . **Aaron Snyder** is eastern regional sales manager for Harris Video Systems. . . . **Joseph Adolph**, M.D., has joined the medical staff of Clinton Hospital in Clinton, Mass. . . . **Jim Deckert** is manager of Decision Systems for Alphatech, Inc. in Burlington, Mass. His group is developing a computer algorithm to assist in designing avionics test facilities. . . . **Paula Jacobs** is director of production and manufacturing development for Seragen, a small biotech firm in Boston. She and her husband, Mike Brooks, have two children.

Norm Rubin works in Toronto with an environmental group called Energy Probe. He is deeply involved in third world energy issues. . . . **Dimitri Procos** has resigned his chairmanship of the Urban and Rural Planning School at the Technical University of Nova Scotia to pursue a Ph.D. in the history of energy in urbanization. . . . **Woody Sullivan** has published *Classics in Radio Astronomy* and is working with a NASA group on developing equipment and strategy for a search for radio signals from other planets.

Thanks for all your efforts in passing class news to me. We actually had a bit more news this month than I could publish. None will go to waste, I promise. Look for it next month.—**Joe Shaffery**, Secretary, 34 Hastings Dr., Fort Salonga, NY 11768

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Sharlotte and I recently enjoyed dinner in Palo Alto at the home of Ginger and **Ed Radlo**. Ed is a patent attorney with Ford Aerospace and is active politically. Ginger is kept more than busy by their charming daughter, Heather Sue, who turned 3 April 29. We also had good fun at a dinner party thrown by **Bill Murray** and his wife, Judy Bolin, at their home in Portola Valley, Calif. Also attending was **Fred Goldman**. Bill, Judy, and Fred are still pursuing their careers as last reported—Bill with Alexander and Alexander in San Francisco, Judy with her own business forms company, and Fred with his own consulting firm in San Francisco. . . . **John Reykjalin** and his wife Ronda Goldstein are now living in Berkeley, Calif. John works as a microprocessor consultant in Silicon Valley. . . . Since leaving Step Engineering, the company he co-founded in 1977, **Steven Drucker** has turned his entrepreneurial energy to developing programs for the IBM personal computer. Steve also finds time for drawing, sculpture, his wife (architect Bonnie Blake-Drucker), his dog "Trouble," and a 76-year-old house in Oakland, Calif. . . . **James Rumbaugh** and Madeline Morrow are planning their wedding for May 29th. . . . **Pete Amstutz** has transferred to Geneva to become managing director of First Chicago S.A., an investment banking subsidiary of the First National Bank of Chicago. His second child, Petey, was born in November 1982. Petey will be Swiss and American like his father and, judging from his work on his pacifier, an engineer too!

Eric Johnson, formerly executive officer of the M.I.T. Sustaining Fellow Program and assistant director of the Industrial Liaison Program, has been appointed assistant dean for resource development in the M.I.T. School of Engineering. . . . **Chin-Hsien Wang** has been awarded a Senior U.S. Scientist Award for 1983-1984 by the Alexander von Homboldt Foundation. He is a professor of chemistry at the University of Utah and will spend six months in 1984 working in Univasitat Mainz. . . . Louise and **Stan Rose** live in Lawrenceville, N.J., with their two children. Stan commutes to New York City where he is vice-president and in charge of the computer systems mini-computer support services group at Bankers Trust Co. The Roses enjoyed seeing old friends at last year's reunion and look forward to our 20th. **Andrew Lemer** is a division vice-president at PRC Engineering, where he is responsible for international programs. A major share of his time is devoted to an associate company PRC (Niagara) Ltd., but diversions occur in the form of promotion and projects in such places as Indonesia, Argentina, and the Ivory Coast. . . . **Bob Landley** has returned to the United States after five years on Kwajalein in the South Pacific. He is still working for RCA, but now in Moorestown, N.J.—**Jim Swanson**, Secretary, 878 Hoffman Terrace, Los Altos, CA 94022

68 15th Reunion

Mike narrowly managed to give the "Blizzard of '83," as it has come to be called in Washington, the slip, taking off from National Airport two minutes before it closed, for several weeks of meetings in Japan. I will join him there next week. **Bob McCrory**, my classmate both as an undergraduate and in the Department of Nuclear Engineering is director of the University of Rochester's Laboratory for Laser Energetics, which is internationally known for its research in laser fusion and for its leadership role as a collaborative effort of industry, government, and a university. Bob has been with the laboratory since 1976. He is also the founder and chairman of the national Consortium of Universities Concerned about Campus Computing, an organization representing 14 universities, established this year to acquire super-computers for universities.

Two adoptions to report this month. Marilyn and **Ron Rosen** adopted a son, Alvin, who is now 8 years old and in the second grade. Ron writes, "We very quickly came to enjoy 'instant parenthood,' and we have now added to our duties such joys as leading a cub scout den. To say the least, it has been a busy, rewarding year for us!" . . . Loretta and **George Goldmark** write that they adopted a baby girl, Jessica Ann, born January 25. George has been practicing orthopedic surgery in New York City for the past five years.

Ron Burd writes that he has been enjoying family life in Lexington, Mass., with his wife and two sons, ages 4 and 1. In September 1981, he was appointed associate director of the Judge Baker Guidance Center as well as associate director of the Department of Psychiatry at the Children's Hospital Medical Center in Boston. He adds, "I'm looking forward to our 15th Reunion in June 1983, hoping that there's a good turnout from '68 'Sammies.' "

On the business front, Bob, '67, and **Ron Howard** have organized a telecommunications company to provide private line service in the local calling area for large volume users. The delivery method uses microwave, which is especially well suited for high-speed data transmission and other digital information streams. The company, First Communications Group, Inc., is looking for good people in marketing and operations and invites inquiries from interested alumni (305-447-7500). . . . **Karen Brothers** writes that she is now vice-president of Software Development at Warner Eddison Associates in Cambridge, supporting their software package INMAGIC, and fills her spare time chairing the Wayland Finance Committee. Dennis ('78) is self-employed, doing computer systems design. Their oldest is now in high school, "and that is an experience!"

Ron Cohen writes that he is alive and well and living in Oakland, Calif. He's been working in the magnetic fusion energy program at Lawrence Livermore Lab for the past eight years, along with a number of other M.I.T. alumni. He's been married for the past four years. He reports: "I've been intending to write this note for several years, but laziness has prevailed." We're glad you finally overcame ol' laziness, Ron, and hope you set an example for others. . . . **Sherman Hanna** writes that in June 1982 he was appointed acting head of the Department of Family Economics at Kansas State University in the "little apple," Manhattan, Kans. . . . **Dexter Snyder** has been promoted to senior staff research scientist in charge of a resource recovery and electrochemical technology group at General Motors Research Laboratories. He lives in Birmingham, Mich., is married, and has three children. . . . Finally, our briefest note of the month, which I quote in its entirety, is from **Randal Fischer**. "Standard Oil Co. (Indiana); director of financial controls (corporate)." We do not, on this job, offer any awards for such brevity, or we'd be out of business!

When you read this, the reunion will be only a few weeks away—hope to see you all there!—**Gail** and **Mike Marcus**, 8026 Cypress Grove Ln., Cabin John, MD 20818

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Adrian Bejan, professor of mechanical engineering at the University of Colorado, Boulder, has written a book, *Entropy Generation Through Heat and Fluid Flow*, published by John Wiley and Sons, which aims to bridge the gap between fluid mechanics, thermodynamics, and heat transfer. . . . **Richard Lawrence Roth** has been elected to fellowship in the American College of Cardiology. . . . **Benjamin R. Roberts** is living in Silicon Valley with his wife, Judy. He is vice-president at Anderson Nichols Co. and continues to do research at Stanford University as a consulting professor. . . . Congratulations to **Raymond Kwasnick** and his wife, Susan, for the birth of a son, Benjamin Noah, in August 1982. . . . **Craig J. Richardson** and his wife, Kathe, had their first child, Sarah, in April. . . . **Richard Stat** is a developer of One Commerce Center, Wilmington, Dela., an 11-story high rise condominium office building. . . . **John Kolp, Jr.** is vice-president of research and development for Symbolics, Inc., a leader in computer systems for artificial intelligence research and applications (also a spin-off of the M.I.T. AI Laboratory). . . . **John Malarkey** is a recent grad of the Harvard Business School and is currently working in Boston at the Charles River Partnership, a $70 million venture capital fund investing in high growth technology companies. He is still rowing at the Cambridge Boat Club and won the master's nationals in a four plus last summer.

Mike Gilmore is adjusting to married life, having survived a honeymoon to Reno and San Francisco (and a snowstorm on Donner Pass between them), two stepsons (9 and 11), and a troglodytic bachelor party. . . . **Bill Swedish** is a group leader at the MITRE Corp. working on advanced automation for air traffic control for the FAA. His wife, Linda, is still an attorney with the SEC in D.C. Their twin girls, Kristin and Jennifer, will be 4 in February, and they are expecting a third child in June. . . . One of my old Course I buddies, **Janet Koch** writes: "I now work as an economist in the Energy Department at the World Bank in Washington, D.C. (Have done so since September 1979, when I finally left M.I.T. and the Boston Area.) I primarily work on petroleum projects in such countries as Portugal, Romania, Philippines, although in the past I also did some work in Pakistan, Sudan, Egypt—all hard work but also very interesting, particularly working with various cultures, etc. Washington is a good city to come to after Boston with plenty of interesting things to do and see (when one has the time to do and see them). The World Bank is also a good place, as it is truly an international organization with a very varied and interesting staff (from everywhere!) and an intellectually stimulating (by and large) atmosphere." Janet was one of the brightest (and nicest) of our classmates in Course I. It is good to hear she is doing so well.

Please write and tell me about your children, jobs, wives, vacations, news of other classmates

and anything else you can think of that the editor will print.—**Hal Moorman**, Secretary, P.O. Box 1080, Brenham, TX 77833

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Wilford Gardner and Mary Jo Richardson, Ph.D. '80, are both oceanographers at Lamont Doherty Geological Observatory at Columbia University. Wilford got his Ph.D. at M.I.T. in 1977. They had their first child, Megan Michelle, on October 14, 1982. The family is doing well. . . . **Bill Ku** is teaching physics at Columbia. . . . **Norman Kohn**, M.D., is practicing neurology in Chicago. . . . **Walter Woodington** has just finished a master's, specializing in microwave engineering at the University of Massachusetts, Amherst, on a program sponsored by Raytheon Co., where he has been since 1979. He studied remote sensing under a great teacher and dynamo, Professor Calvin Swift, '59.

Jose A. Lopez has been named general manager of PNP, Inc. based in Austin, Tex. . . . **Lou Clark** decided that the way to make his mark on the world is by writing video games. His goal is to have one of his games in every bar in the U.S., but no progress report yet. . . . **Bob Haworth** left Kearney and Trecker and started at General Electric's Medical Systems Nuclear Magnetic Resonance Group. . . . **Alfred Morgan** reports that from Santo Domingo they go to Lima, Peru, where they will arrive for the end of the Peruvian summer. He will be taking up cultural affairs work, but is most excited about Macchu Pichu and the Andes. He's also looking forward to cool weather. Sends his congrats to **Bonnie Kellerman** for the great job that she did on the reunion which he regretfully missed, but he hopes to make the 15th. . . . **Charles Fly** is a general partner of Non-Trivial Solutions and is also on the board or an officer of Hydro-Jet Services, Marine Metals, Hydro-Toro Pump Co., Fly Enterprises, Tuff-N-Lite, and Wing Things. He has been busy with all those enterprises.

Becky Donnellan and Nat Karch started the year with a big bang. They decided to get married and were blessed with a spring-like day and a house overflowing with friends to help them celebrate, including **Charlie Mann** and his wife, Karen and Greg Arenson (both '70), Louise and Gerry Grochow ('71 and '68), Dave Burmaster ('69), and yours truly. Needless to say, the bride looked elegant and a good time was had by all in spite of those of us who were suffering from too much New Year's Eve, followed by morning flights to D.C. . . . **Michael Sims** is practicing sporadic emergency medicine in outlying hospitals since his discharge from the Air Force. His wife, Janine B. De Coster (Wellesley, '72, member, International Brotherhood of Carpenters and Joiners) designed their house and is a designer and construction supervisor. . . . **Vo T. Han** has been transferred to Singapore to work as deputy manager of the Bank of Montreal with responsibilities for Singapore, Thailand, Malaysia, Burma, and Brunei. From 1979 to 1981 he was in the bank's Manila branch, and before that in Toronto in the bank's Project Finance Group.

Douglas Mahone and his wife Lisa Heschong have a very active daughter, Amber. Since he left M.I.T. he has rejoined TEA, Inc. a solar research and design firm founded by Bruce Anderson ('69). Doug is a registered architect, director of research, and a vice-president. The practice is so diverse that it is a lot like trying to run four separate businesses at once. . . . **Alan Henricks** has been promoted to senior vice president at Atari. His daughter is becoming an expert at video games. They have moved into a house "big enough (almost)" to handle his two children. Alan asks what ever happened to Larry Speck ('71)? . . . **Peter Hutzel** has been appointed a vice-president of Johnson and Higgins, the international insurance brokerage firm in New York City. . . . **Richard Solbrig** has been a registered civil engineer in California since 1977. He has been working for John Carollo Engineers in Walnut Creek as a project engineer designing sewage treatment plants.

Chris Hill recounts that after he got his S.B. and M.S. he went to Caltech where one of their nobel laureate's noted, "We'd rather slaughter our children than send them here for an undergraduate education." But he says the graduate school was delightful. After his Ph.D. in 1977, he went to the Enrico Fermi Institute for postdoc work. In 1978 he and Laura got married; and daughter Katherine came in 1979. He then went to Fermilab where he is in a five-year associate scientist position with a chance of tenure. A son, Graham, has been born in the Chicago ex-urbs. They are thoroughly enjoying the semi-rural life but hoping for a year abroad. Parting questions—what happened to his old friends and East Campus 5-East dormmates, the flourescent dragon, and "arcrylic frescoes'? Has the tradition of acetylene and oxygen flourished or faded? . . . And with that let me bid you all to keep the notes coming. Have a great spring.—**Wendy Elaine Erb**, 531 Main St., Apt. 714, New York, NY 10044

73 10th Reunion

We had a fairly decent response to the requests for information this month. **Mary Jean Crooks** qualified for the Boston Marathon by running the Philadelphia Marathon in 3:19. She'll be in Boston for Patriots' Day. . . . **Nick Hamisevicz** married Anne Moran (Wellesley, '75) on August 18, 1979. After a European honeymoon and a gap of two and a half years, their first child, Nicholas III, was born on April 18, 1982. . . . Tina and **Trip Barber** had their second daughter, Maria, on July 29, during an infrequent port stop in his three-year tour as weapons officer on the *U.S.S. Moosbrugger*. Professionally, it has been an exciting year for the Barbers, with Trip conducting operational evaluation tests on new destroyer sonar systems.

John Dulcey completed his residency in internal medicine and has entered practice in Sellersville, Pa. John and his wife Martina (Simmons, '75) had their first child, Patrick, this past July. . . . Precious little can be reported in the Virginia end of the world. Ruth and the kids are well, and tax time is in full swing. And it's reunion time.—**Robert M.O. Sutton, Sr.**, Secretary, 819 Buckingham Ct., Warrenton, VA 22186

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Diane Bracken is still a project manager in a CAD group at Hewlett Packard. She had a wonderful business-pleasure trip to Germany this spring. . . . **Lawrence Summers**, who is serving as the domestic policy economist at the Council of Economic Advisers, will return to Cambridge in September to take up a professorship in the Harvard Economics Department. . . . **Nancy Bell** and Joe Schneider, '77, are pleased to announce the birth of their first child, Katrina Danielle Schneider, on May 14, 1982. . . . **Albert K. Chin** got a master's in mechanical engineering from Stanford, then worked for one year with Hughes Aircraft in Culver City, Calif. He then decided to go into medicine and is now in his fourth year at UCSF med school. In the meantime he has been doing biomedical design in cardiovascular surgery. He has received five patents, including one for the "Fogarty-Chin linear extrusion catheter." Said instrument will be on the market in a few months and is used for balloon angioplasty. He is married and has two daughters, a 4-year-old and a baby.

Edward Capparell's first child, Elizabeth Yeman, was born April 30, 1982. In June he finished a residency in family practice. He is currently the director of a rural health care system in the Dominican Republic that covers 800 square miles and 120,000 people. He can be contacted c/o Plan Sierra, Apartado 1152, Santiago, Dominican Republic. . . . **William Huse** received his M.D. and Ph.D. from Einstein College of Medicine in 1982. He is currently doing postdoctoral work at Cold Spring Harbor Laboratories. . . . **Diane Gilbert** left Arthur D. Little to become the marketing manager for Steinbrecker Corp. in Woburn, Mass., a fast growing hi-tech firm "full of M.I.T. people." She finds the variety of the work to be really stimulating. . . . **Cleve Killingsworth, Jr.** was elected to the board of directors of McKinley Community Services, a Chicago private social services agency. He is executive director for Health Information and Data Services at the American Hospital Association.

David Kat's son, Robert Steven, will be a year old in May. He adds: "As our economy sinks slowly in the East, I've been able to hold on here at Burns and McDonnell (28th largest architect/engineering firm in the U.S.) in spite of a 25 percent staff reduction and a 'voluntary' work week reduction of 10 percent (one day off every two weeks). Karen has retired from job as personnel manager at Sunshine Biscuit's bakery here. It was the right move all around: Robert, Karen, and I are happy, and our diets are safe—no more free cookies!"

Thomas Olsen received a Ph.D. in physics in May 1982. He married Deborah Kay Hackett on May 15, 1982. **Ken Luey** and Scott Moor, '73, were in the wedding party. **Bruce Miller** (Bemis Fifth) was the best man. Thomas is visiting assistant professor at Lewis and Clark College, Portland, Ore. The above information was kindly supplied to me by our class "prez" **Rich McCarthy**.—**Alex Castaldo**, Secretary, 929 Mass. Ave. (12D), Cambridge, MA 02139

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Please keep the news coming. **Douglas Denholm** writes that he is "currently working on Allis-Chalmers 'Kilngas' coal gasification process in Milwaukee, Wis." . . . **Stanley White** is starting an ocean and coastal consulting engineering firm in Westport, Conn. The firm specializes in port and harbor development, offshore structures, and coastal processes. . . . From **Tom Hirasuna** and **Jean Hunter**: "Jean was elected chairman of Tappan Zee Section, American Institute of Chemical Engineers, for 1983. This is the local section for Westchester and Rockland Counties of New York. . . . **Bernie Tao** is now at Iowa State University (Ames) in a doctoral chemical engineering program. . . . **Ben Szaro** received his Ph.D. in biophysics at Johns Hopkins in September and recently moved to New Orleans to start a postdoc at Tulane. . . . **Robert Winkler** is an assistant professor of naval science at Texas A&M University, working on a master's in computer science.

Dave Agans recently married Gail Blagbrough, a former civil engineer from Tufts. "We are moving into our first home in Nashua, N.H. I've been working for Gould, SEL Division, starting up a remote product development group. The place is loaded with familiar faces, including Doug Durrie, '77, Jerry Dwyer, '81, and, if we offer him enough money, **Gabor Szakacs** will soon be aboard too. Mike Bromberg, '77, hangs around and consults occasionally." . . . **Robert Dyson** pens, "After a couple of years in New York, and three and a half years in western Kentucky, we moved back to the Boston area about a year ago. I am now working at C.T. Main and Co. Audree and I have rejoiced in every moment of our son, Alexander, 14 months old." . . . **Robert Lustig** is currently winding down pediatric residency at St. Louis Children's Hospital, with just a few more months to go. "I currently have plans to move to San Francisco at the end of this academic year, to assume a fellowship in pediatric endocrinology at UCSF-Moffet Hospital. I'm looking forward to the excitement and scenic beauty of the West Coast."

Ira Gerson is currently working in research at Motorola, Shaumburg, Ill., and president of G.T. Computer Systems in Shamburg. . . . **Fred Tsuchiya** writes, "Enjoying my new son, Karl M., born May 1, 1982." . . . **Dan Dershowitz** and Debbie Gross, '77, send word that they have

moved into a condo in Dobbs Ferry, N.Y. . . . **John Robotham** was named the Henry B. Dupont Scholar for the 1982-83 academic year at the Sloan School. Kudos for such excellence. John is concentrating at Sloan on corporate strategy and policy and in management of technological innovation.

As for your secretary, he is scribing these notes at the Intercontinental Hotel in Geneva on a bright, sunny February Swiss afternoon. Word has reached me that Libya unilaterally broke from OPEC and has slashed the price of Bonny Light crude by $5.50 per barrel. Will the world banking system fall apart from this? Are we on the verge of a global financial castrophe or renaissance? As I sit here both worrying and wondering, I can only marvel at the irony. Fears of oil at $50 per barrel are now fears of oil at $20. And a double irony—my hotel is the same one OPEC uses for its meetings in Geneva. I will be leaving before the next one, unfortunately. You can believe it will be a stormy one, and perhaps may be the death rattle of the world's most powerful cartel. The world financial order is about to be rewritten again, with consequences in all the markets I trade.

Why am I in Geneva? I came for a meeting about the future trend of the U.S. dollar against the continental currencies, especially Swiss francs, and to discuss the gold and silver markets, with which the foreign exchange bourses are intimately linked. Also I am here to vacation for several days. But events have changed my plans as is the case with any active futures trader. But the Swiss sunlight passes through my windows and warms my bones.—**Arthur J. Carp**, Secretary, 15 Jones St., Apt. 3D, New York, NY 10014, (212) 741-3023

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Being in print regularly also demands that one make corrections occasionally. I do apologize for any embarassment that errors may have caused, but please remember that I usually can't verify the facts before this column goes to press. Therefore, I now quote from a recent letter from **Caren Penso**, who was incorrectly listed as a member of the Class of '78. "Karyn Altman, '78, is *not* married and living in D.C. She is still quite single and lives in Boston. Sue Hanson, '78, is now married and living in the D.C. area." Karen Altman went to the University of Nebraska for an M.S. in physical education and now coaches the Harvard women's volleyball team. Since graduation, Caren has worked for the CIA as an economist, modeling economies of Brazil, Italy, Philippines, and the Soviet Union, and also participated in efforts to develop world models. Caren still plays softball and volleyball, and officiates at volleyball and basketball games. She's enjoying all sports more since she finally got her knee operated on. Caren wrote about quite a few alumni as well. . . . **Lisa Jablonski** is living in Princeton, N.J. . . . **Jesse Abraham** is teaching in Princeton, and hopes to complete his Ph.D. this June.

Werner R. Haag has just started his second and final year as a chemistry postdoc in Switzerland with a pleasant ski-week with relatives and friends in Zermatt, skiing in the shadow of the Matterhorn. In November, a fellow fourth-wester from East Campus, **Leslie Leow**, visited while playing for the Singapore Team at the World Team Chess Championships in Lucerne. They did some rather exciting hiking in the Alps, but managed to survive to tour Zurich, where Werner lives, take in a play, and play some bridge. . . . **John E. Jamerson** has shifted his focus from corporate finance to corporate real estate investment banking. John is a senior vice-president of Dean Witter Realty in San Francisco and is enjoying West Coast living. . . . **Walter Goodwin** is in his second year in law school in Detroit. . . . **Leigh Wattlington** is also in Detroit, doing an Ob/Gyn internship at Wayne State's hospital network, after completing her M.D. at Harvard Medical School. . . . **Renee Carter** is working for 3M in St. Paul, Minn.

Matthew L. Sherman married Janet Cohen in June 1981, and is finishing his residency at Georgetown University Medical Center. Matthew is presently interviewing for medical oncology fellowship research programs. . . . **Stu Kreloff** is working for John Brown in Delft, the Netherlands (P.O. Box 5254, 2701 GG Zoetermeer), and spends his free time bicycling, rowing, and doing photography. . . . **Brian Hughes** is now senior vice-president of the U.S. Aviation Underwriters, responsible for satellite underwriting. Brian has the insurance on SBS-3, the first spacecraft to be deployed from the space shuttle. . . . **Dan Rice** is an attorney associated with the firm of Tunstead, Schecter, and Torre. . . . That's all the news for now. Do write soon!—**Barbara Wilson Crane**, Secretary, 6431 Galway Dr., Colorado Springs, CO 80907

79

Hello, classmates! I hope all is going well with all of you. . . . **Pete Steinhagen** spent his wedding ferreting around digging up dirt for me! Pete married Janet Rogde (University of Minnesota, '80) in their hometown—Princeton, Minn.—last December 4. Pete and Janet were high school classmates who got to know each other better when he returned to Minnesota after graduation to work for 3M. The happy couple honeymooned in Puerto Vallarta, Mexico, and had a great time, especially parasailing. They are now living in St. Paul (1534 Selby Ave., to be exact! Zip is 55104.) in a house with a guest bedroom (hint, hint!) While Janet looks for a teaching job in math, Pete is continuing his job with 3M, and resuming M.B.A. classes (only three semesters to go). Here's the news Pete was able to gather at the wedding. . . . **Joe Kracunas** is "heavy into computers" with General Electric in Lynn, Mass., and spends his free time mountaineering in, among other places, New Hampshire. Joe was a groomsman in the wedding. . . . **Al O'Connor**, who served as photographer, is a lieutenant in the Air Force in Redlands, Calif. He spends a great deal of time on the road (especially to Boston) while helping with the MX missile! . . . **John Hayashi** recently graduated Georgetown Law School and is now employed by the accounting firm of Coopers and Lybrand in St. Louis. . . . Also at the wedding were Jeff Olson, '81, and Andy Ubel, '81. Unable to attend but "alive and well in Boston" are **Tom Berman**, **Bruce Wrobel**, and **Gary Spletter**. . . . Congratulations, Pete, and thanks for all the gossip!

Bruce Kulik correctly named the three rivers that run through Pittsburgh, as queried in a previous column. (That's Allegheny, Monongahela, and Ohio!) Bruce got his master's in electrical engineering from Worcester Polytechnic Institute in 1981, in conjunction with his job in the advanced engineering program at Honeywell Information Systems in Billerica, Mass. Bruce describes the program as "three years of six-month assignments, sort of like infinite summer jobs!" (Sounds like my job, except I only have to suffer through two years!) Bruce is currently the technical leader of a project with the design automation group at Honeywell. . . . **Jose Perez** is with a firm in downtown Boston called JSI, with whom he is a part-time programmer/consultant. Jose reports, "Right now the jury is out on my thesis, and life is at a standstill." . . . Also employed in downtown Boston is **Catherine Busch**, who works at an architectural firm. She recently had a wonderful time traveling with a friend to: India, Kathmandu, Nepal; Rangoon and Mandalay, Burma, and Bangkok, Thailand. . . . **Larry Rosenstein** spent three more years at M.I.T. getting his S.M. degree (I guess you have to be into S and M to stay at M.I.T. three more years!!!). He's now in the San Francisco Bay Area working for Apple Computer.

Gerald Melsky just accepted a position with Infusaid Corp., a manufacturer of implantable drug infusion pumps. . . . **Mike Patrick** is "still sweltering in Houston for Texas Instruments!" . . . **Philip Stein** is a fourth-year grad student in chemistry at the University of Pittsburgh. . . . **David Strauss** was interviewed in the 1982-1983 issue of *Career Insights*. David is a legislative correspondent for a moderate Democrat in the Senate. David's search for a job on Capitol Hill was facilitated by his job the previous summer with a first-amendment public interest group. His day is spent responding to mail, meeting with constituents who are visiting Washington, talking with interest groups to learn more about their perspectives and plans, and researching legislation. . . . That's all for now, folks. Please write soon. My mailbox is getting mighty sick of nothing but bills and things addressed "Occupant"!—**Sharon Lowenheim**, Secretary, 131 E. 83 St., Apt. 2G, New York, NY 10028

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This past month I had the pleasure of attending the wedding of **Ronald Wides** to Ellen Ahankman in Washington, D.C., on February 20. Ron is working on a Ph.D. in bio-chemistry at Johns Hopkins University. . . . Speaking of weddings, I have been negligent in reporting the marriage of **Bruce Fish** to Lori Shindler in Agawam, Mass., on May 23, 1982. They are now living in Clark, N.J., where Bruce has taken over the family business. . . . Back in the hub, **Darrell Hartwick** has transferred to a Digital plant outside the Boston area, but continues to live in town. . . . After working for two years in engineering at Computervision, in Bedford, Mass., **Bill Warner** took a new job in product marketing at Lexidata, a maker of computer graphics hardware and software. Bill says that "the new job has provided an exciting challenge and a window on the world of computer graphics." Last July, Bill married Donna Wainwright. Donna is now running New England Handcycles, which is manufacturing the hand-peddled cycle that Bill designed for a senior thesis.

Ben Teno is dabbling in real estate investment and classic car restoration as well as designing a handling system for a towed sonar system which will be marketed to foreign navies by his current employer, Raytheon. . . . **Timothy Folster** is working for a large construction company in northern New England. Tim is project manager for the development of a 41-unit Section 8 housing project. . . . **Peter Lemme** has been enjoying flying on the new Boeing 757, while flight testing the autothrottle. He is also enjoying Seattle, where he has been playing softball and hockey, and has been hiking and skiing.

In the world of academics, **Kim Zaugg** is finishing an M.S. in astronomy and starting the Department of Education program in higher education at Pennsylvania State University. Kim has decided to become a college administrator, and "leave the stargazing for the nightowls." In October, Kim was elected vice-president of the Graduate Students Association at PSU. . . . **Tom Russ** is the tutor in M.I.T.'s German House, while working on his M.S. in computer science.

Jamie Burnside, working for Stone and Webster in Boston, has taken a temporary field assignment in Shoreham, N.Y. (on Long Island). Jamie will be doing field quality control for a few months. . . . **Ron Efromson**, who has spent the last few years on the West Coast working for Hughes, has recently returned to the Boston area. Ron is now working for Lincoln Labs and living in Lexington.

As for myself, I am getting ready for a temporary move to Germany, which should occur some time this summer. Letters and cards will still get to me at the address below, however. I am disappointed to see that the personal correspondance has slowed to a halt. Almost everything I write is a result of personal contact or of people writing in their activities when making contributions to the Alumni Fund. Surely there are others of you out there. If you want to read about what your friends are doing, then let them know what you are doing.—**Ken Turkewitz**, Secretary, 3 Winslow Rd., Belmont, MA 02178

Courses

I

Civil Engineering

Eric F. Peyrard, S.M.'82, reports that since January 1983 he has been assistant to the director of the Maracaibo (Venezuela) Transportation Institute and that he is to be married on June 18, 1983 (in Paris) to Margaret A. Fullerton, daughter of **A.S. Fullerton,** S.M.'59.

Max D. Sorota, S.M.'50, has been elected president of Fay, Spofford & Thorndike, Inc., Boston. He has been with the firm since 1951—most recently as project manager responsible for the design of the drydock for Trident-class submarines at the Naval Submarine Base, Bangor, Wash. . . . **John D. Bridwell,** S.M.'66, formerly vice-president/marketing services and planning for GTE Business Communications Systems, Stamford, Conn., has been named director of productivity services of GTE. And **S. Bruce Smart, Jr.,** S.M.'47, chairman and chief executive officer of the Continental Group, Inc., has been elected a GTE director.

Ru-Liang Leon Wang, Sc.D.'65, is a professor of civil engineering and environmental science and Graduate Structural Program advisor at the University of Oklahoma, Norman. He is currently doing research on lifeline earthquake engineering under the support of the National Science Foundation. . . . **Louis H. Roth,** S.M.'47, is currently manager, Electrical Services—Regional Transportation District, Denver, Col. . . . **Frederick G. Lehman,** Sc.D.'39, writes, "After 36 years, I will be retiring in June from full-time service as Distinguished Professor in Civil Engineering at the New Jersey Institute of Technology.

IV

Architecture

Paul Earls, fellow in the Center for Advanced Visual Studies, and Joan Bingham and Wen Yin Tsai, former CAVS fellows, are submitting sketches of water sculptures as prefinalists in the First International Water Sculpture Competition, a project of the 1984 Louisiana World's Fair. Ten of the works sketched by 30 prefinalists will be commissioned for display at the fair.

R. Gregory Turner, S.M.'77, has been named an associate of Caudill Rowlett Scott, Houston, Tex. He is a project manager for CRS and has been involved in the Gulf Oil Corp. Regional Headquarters Office Building in Houston. . . . **John Sullivan, Jr.,** M.Arch.'38, reports, "I retired from the practice of architecture in 1975 from the firm of Sullivan, Lecklider & Jay. I was also director of the Dayton Foundation (June 1973 to December 1982)." Mr. Sullivan was leaving on February 12, 1983 to visit New Zealand and Australia with two daughters, and he was planning a one-man water-color show this spring.

Brian C. O'Neill, M.Arch.'82, has been hired as an intern project design architect with John Portman & Associates, Atlanta, Ga., currently assigned to a 22-acre hotel and retail facility being built in Singapore. . . . **Dennis Roth,** M.Arch.'75, has been appointed project director of space planning of Jung/Brannen Associates, Inc., Boston, responsible for major interior projects and management of the Interiors Division; his current assignment is on interior design for the Transportation Headquarters Building, Park Square, Boston.

V

Chemistry

Professor **Christopher T. Walsh,** head of the Chemistry Department at M.I.T., is co-chairman of a task force on chemistry in the life sciences—a part of the Committee to Survey Opportunities in the Chemical Sciences commissioned by the National Academy of Sciences/National Research Council. The $500,000 study of the chemistry profession is to be completed by the end of this year.

C. James Bier, Ph.D.'71, associate professor of chemistry and environmental science at Ferrum College, Ferrum, Va., is the inventor of a new passive heating system utilizing masonry columns placed at 45° angles behind south-facing glazed walls (*see illustration*).

John A. Schneider, Ph.D.'66, reports, "I just returned from three years in Brazil where I was the Chemicals Department manager for Dow Chemical Co. I am currently manager of marketing research—new opportunity development for Dow." . . . **Frank M. Armbrecht, Jr.,** Ph.D.'68, has been appointed a technical manager of Dupont Polymer Products Department and has returned to Wilmington, Del., after four years managing process research at two plant sites near Beaumont, Tex.

Joseph Irgon, Ph.D.'48, writes, "For the past ten years I have been developing and testing the principle of light-refracting force fields, as well as some ideas in resource recovery. Woe unto my plans for retirement!" . . . **Eugene A. Burns,** Ph.D.'56, is currently vice-president of S-Cubed and manager of the Chemistry and Chemical Engineering Group.

Sidney Sussman, Ph.D.'37, of Stamford, Conn., passed away on October 27, 1982; no details are available.

VI

Electrical Engineering and Computer Science

Amos E. Joel, Jr., '40, a telephone switching expert at Bell Labs, has completed *A History of Engineering and Science in the Bell System* and now has the assignment of surveying and evaluating new switching system developments in the U.S. and abroad. He's the author of two books on mechanical and electronic switching technologies.

Chathan M. Cooke, Ph.D.'70, associate director of the M.I.T. High Voltage Research Laboratory, is the beneficiary of an unusual gift from Japan: a sample of bismuth silicon oxide crystals. The bismuth material has an unusual ability to convert electrical signals into proportional optical signals, and Dr. Cooke is using it to detect currents in compact power transmission apparatus. Conventional electronic detectors can't be used because they must be operated at ground potential.

Professor **Henry Ledgard,** Ph.D.'69, of the Department of Computer Science at the University of Massachusetts in Amherst, is the author of *From Baker Street to Binary* (Harper and Row). It's the third in a series of popular books on computers by Dr. Ledgard; in all three Sherlock Holmes and Dr. John Watson are the main instructors. That's because he and his collaborator Andrew Singer "wanted something that would knock people's socks off. . . . The single largest failure of the computing industry," he told Richie Davis of the *Greenfield* (Mass.) *Recorder*, has been to leave the lay person behind by providing "dry, humorless, and unimaginative" explanations of technology.

Frederick Hottes, S.M.'67, writes from Salt Lake City, "Not much has changed out here. I did get to visit Boston in 1982. It was an opportunity for some nostalgia—seeing old friends and places—plus, after typical Boston treats like the wildcat MBTA strike, time to be homesick for the good old West." . . . **Lee S. Tuomenoksa,** S.M.'54, former vice-president of Bell Laboratories, Inc., has become vice-president of customer service for American Bell. . . . **Laurence Swain,** S.M.'60, general manager of Datacon, Inc., Burlington, Mass., is also a talented musician. He recently played the piano at the annual membership reception of the Friends of the Scituate (Mass.) Town Library. He has been noted as having "an interesting repertoire of old standards and popular songs," in a article in the *Scituate Mariner*, as well as being a talented guitarist.

Royal K. Joslin, S.M.'46, of Philadelphia, Penn., passed away on April 10, 1982; no details are available.

VI-A Program

VI-A has gone over the top again, with a record 224 students having applied for June 1983 admission to the Program! This represents about 64 percent of the current VI-A sophomores—a highest for this percentage—ever! Two years ago 196 students applied, the record which now has been exceeded.

These applicants went through two days of interviews with representatives of the VI-A cooperating companies on March 1 and 2—a total of 1,068 interviews! The companies, who came up with a record of their own—127 openings—despite recession and hiring freezes, reported being very impressed with this year's applicants.

Maintaining its policy of limiting the VI-A Program to a total of approximately 250 juniors, seniors, and graduate students, the department

will again allow only 90 to 95 of these openings to be filled. Thus this becomes the first year since the imposition of this departmental restriction that companies had their available openings cut back by the department. The ratio of applicants to vacancies is 2.36:1

Nor is there any dirth of companies desiring to join VI-A. Hardly a week goes by without a contact between a company and the VI-A Office about joining or reiterating a previously expressed desire to do so. The limitation imposed by the department is based on the ability of the department's faculty to adequately monitor the program and to supervise the company-based master's theses.

A number of the participating companies have had their recent VI-A graduates return to conduct the company-run open house and the interviews which follow: **Geoffrey J. Bunza,** '74, for GenRad; **Dean R. Collins,** '58, for Texas Instruments, Inc.; **Joel A. Feldman,** '79, for Lincoln Laboratory; **Daniel G. Jablonski,** '76, for the Naval Surface Weapons Center; **Theodore M. Lyszczarz,** '74, for Lincoln Laboratory; **Victor L. Ransom,** '48, for Bell Laboratories, Inc.; **Daniel M. Sable,** '80, for RCA/Astro; **William M. Shiley,** '81, for Fairchild/South Portland; and **Steven M. Weiss,** '81, for Hewlett-Packard Computer Division.

This year VI-A had the distinction of having one of its company coordinators complete 23 years of association with the program. Doran L. Morrison of the General Electric Co.'s Ordnance Systems Division, Pittsfield, Mass., was honored at the annual VI-A dinner on February 28 before some 120 company people and faculty.

Another event of significance for the VI-A Program was the presence on board the fifth Space Shuttle flight of our own **William B. Lenoir,** '61. Bill was on campus February 22 for an evening's lecture sponsored by the local Tau Beta Pi chapter.

Michael A. Isnardi, '82, a VI-A graduate student with Bell Laboratories who is going on for his doctorate at M.I.T., has brought honor to VI-A. Mike is one of the ten winners, nationwide, of this year's "Honeywell Futuristic Award Competition" in which each contestant writes essays "describing technology advancements by the turn of the century and how these developments would change our world." The ten winners, each receiving $2,000 at an awards banquet in Minneapolis on February 21, were selected from among 456 student entries from 191 different schools.

At the 1983 winter meeting of the IEEE Power Engineering Society on February 1, **Andrew F. Corry,** '44, was presented the William M. Harbirshaw Award. This award is given for "outstanding contributions to the field of electrical transmission and distribution." The award consists of a bronze medal and $1,000. Mr. Corry is currently a senior vice-president of the Boston Edison Co., a fellow of the IEEE, and a member of the National Academy of Engineering.

Chester M. Day, Jr., '57, recently called John Tucker while interviewing at M.I.T. for Satellite Business Systems, McLean, Va. He said that his son, Stephen, has been granted early admission to M.I.T. and will be the third generation of Days to attend. Chet's father was class of 1928 and also a VI-A graduate.

At M.I.T.'s VLSI conference last December 10, John Tucker met and chatted with **Philip B. Giangarra,** '76, who works for Codex Corp., Mansfield, Mass. He and his wife live in Mansfield and were expecting their second child at that time.

VI-A alumni/ae signing our guest book recently have included: **David M. Bernstein,** '72, at M.I.T. recruiting for TRW, Inc., where he's now a section head; **Eric D. Black,** '77, recruiting as director of technical development for Gould, Inc.; **Steven K. Ladd,** '81, an engineer with Megatest in California; **Michael W. Patrick,** '80, recruiting for Texas Instruments, Houston, Tex.; **Lynn M. Roylance,** '72, here with Hewlett-Packard's recruiting team for H-P Labs.; **John R. Selin,** '69, a section manager with Raytheon Co., Wayland, Mass.; and **Wayne M. Seltzer,** '81, an engineer with NBI, Inc., Boulder, Colo., where he's involved in a new research division.—John A. Tucker, Director, VI-A Program, M.I.T., Room 38-473, Cambridge, MA 02139.

VII

Biology

Monte Kreiger, assistant professor of molecular genetics at M.I.T., is the recipient of a $25,000 Basil O'Connor Starter Research Grant from the Massachusetts March of Dimes Birth Defects Foundation. His proposal is for a study of mutant cells that—because of a genetic defect—lack the ability to bind and internalize cholestertol and related substances.

Edward S. Josephson, Ph.D.'40, completed in November 1982 a one-month mission to the government of Chile for the United Nations International Atomic Energy Agency to advise and assist Chile's Nuclear Energy Commisssion on preserving food by ionizing energy. Also, he along with Martin S. Peterson co-edited the three-volume book *Preservation of Food by Ionizing Radiation*, published by the CRC Press, Inc., Boca Raton, Fla. (December 1982). . . . **Richard S. Gordon,** Ph.D.'54, writes, "I have recently accepted a professorship at Arizona State University, Tempe, where I will also be director of the New Crop Applied Science and Technology Center (ASU-NEWCAST), dedicated to developing new crops and new products derived for the world's arid zones (i.e., oil from jojoba, and rubber from guayule)."

XI

Urban Studies and Planning

Thomas J. Piper, director of video programs for the Laboratory of Architecture and Planning, is the winner of a New England Emmy for "Life with 2 1/2: The Tax Dilemma." The one-hour television documentary was an outgrowth of the laboratory's "Proposition 2 1/2 monitoring project," and it won the New England award for outstanding educational programming from the National Academy of Television Arts and Sciences. Mr. Piper was the author and coproducer.

Philip L. Clay, Ph.D.'75, and **Gregory A. Jackson,** '70, are among four authors of *Future Boston: Patterns and Perspectives*, a new publication of the Joint Center for Urban Studies (Harvard-M.I.T.). Four economic and demographic mismatches are forecast for 1980 to 2000: increasing demand vs. decreasing supply of well educated entry-level workers; growing numbers of nontraditional households vs. a shrinking supply of appropriate housing; small innovative business seeking Boston locations vs. incentives for established businesses to do so; and a rapidly oscillating population (baby-boom, then baby-bust).

Joyce Chieh-Chun Wang, M.C.P.'61, currently heads the research section of City of Oklahoma City, Okla., conducting urban information, geoprocessing, and urban system modeling projects. . . . **Arthur W. Busch,** S.M.'52, is a visiting professor in the graduate program in environmental sciences at the University of Texas, Dallas, for the 1982-83 term.

XII

Earth and Planetary Sciences

Charles M. Swift, Jr., Ph.D.'67, writes, "I am now chief geophysicist for Chevron Resource Co., the non-petroleum subsidiary of the Standard Oil Co. of California. We are involved in the exploration for, and the development of, mineral and geothermal resources—a challenge in today's economy."

Irving A. Breger, Ph.D.'50, a geochemist with the U.S. Geological Survey, passed away on October 13, 1982; no details are available.

XIII

Ocean Engineering

The name of the late Captain **Gordon W. Underwood, USN,** S.M.'42, has been given to a new guided missile frigate that joined the fleet on January 29. It's the only active Navy ship to be named for a former submarine commander. As commanding officer of *Spadefish* during three patrols in World War II, Captain Underwood was credited with the sinking of 76,000 tons of enemy shipping in the western Pacific.

David J. Space, '56, a captain in the U.S. Navy has retired after 37 years of service. He has been decorated twice with the Meritorious Service Medal and the Navy Commendation Medal for outstanding professional achievement. His last post was officer in charge of the David Taylor Research and Development Center, Bethesda, Md. . . . **Henry Marcus,** S.M.'67, has been elected Council member of the Society of Naval Architects and Marine Engineers. . . . **Robert L. Haron,** '73, former executive vice-president—commercial, at McDonnell Douglas Automation Co., has become corporate vice-president—civic affairs of McDonnell Douglas Corp.

Carl A. Wales, S.M.'82, writes that he was on board the first attack submarine USS *Tautog* (SSN 639) when it participated in the first winter submarine rendevous on November 20, 1982. He was riding the *Tautog* (when it operated in the Arctic and surfaced at the North Pole) as part of his training to be qualified as an Arctic/ice pilot (as in river or harbor pilot). This achieved his goal of getting to the Pole which started when he was an undergraduate in Course XIII in 1973. In his three previous trips to the Arctic—1973, 1974 (as an undergraduate), and 1982 (to do thesis research for his degree)—he had never been closer than two hundred miles from the North Pole.

XIV

Economics

Daniel L. McFadden, who came to M.I.T. five years ago to be professor of economics, now holds the Elizabeth and James Killian Class of 1926 Professorship. In the citation for the award, McFadden is described as "one of the most complete economists of his generation"; his current work is on analysis and forecasting of engineering economic systems.

Armand V. Feigenbaum, Ph.D.'51, has recently written *Total Quality Control* (McGraw-Hill), a "vital resource for anyone who has a direct stake in business survival and success in today's turbulent economic environment." The book explains quality control principles needed for achieving productivity, market penetration, and competitive advantage.

Technology and Policy Program

Richard Thomas, S.M.'79, is presently working at Arthur D. Little Co., in the engineering sciences group on projects involving wind energy. . . . **Joseph Egan,** S.M.'79, has recently completed a book, *Mini-Nukes–Life After Death for Global Nuclear Power*, which describes the revolutionary changes in the nature of the nuclear power industry in industrialized countries. A second book—a novel loosely based on M.I.T., *Tillers of the Pantheon*, is in progress. **Jay Lingamnei,** S.M.'81, is presently working for Xenergy, Burlington, Mass., doing load management studies for utility companies.—Professor Richard de Neufville, chairman, Room 1-138, M.I.T., Cambridge, MA 02139.

Tuition Goes to $9,600 Up Faster Than Inflation

Tuition, board, and room at M.I.T. will be 10 percent higher in 1983-84 than in 1982-83. Tuition itself will move up from $8,700 to $9,600 (two terms), and the combined average costs for tuition, room, and board for students living in M.I.T. dormitories will rise from $12,250 to $13,480.

The increase is higher than the rate of inflation, and no one is happy about it. President Paul E. Gray, '54, noted simply that other income streams—investments, gifts, and research overhead—have not kept pace with inflation, and the Institute's cost-reduction programs haven't yet reached their three-year goal. Constantine B. Simonides, '57, vice-president, told *The Tech* that two factors were chiefly responsible for rising costs: the need to increase faculty salaries, and the need to increase engineering teaching resources to match the rapid increase in the number of undergraduates choosing engineering majors. "We can't just cut people (in other departments) to save money," Mr. Simonides told John J. Ying, '84, of *The Tech*.

But Dr. Gray promised that "M.I.T.'s commitment to support talented students regardless of their financial means is undiminished," and Peter H. Richardson, '48, director of admissions, said that there will be a 32-percent increase in scholarship funds in 1983-84. As a result, M.I.T. will continue its policies of admitting students independent of their need for financial aid and of meeting the full demonstrated need of all undergraduate students.

Student reaction was predictably unenthusiastic but mainly temperate. One letter-writer to *The Tech* (name withheld) characterized students as "pawns of the M.I.T. Corporation" and invited disgruntled colleagues to telephone a "tuition riot hotline." Another group distributed cards addressed to Dr. Gray on which students could give the president examples of how high costs had affected their lives. *The Tech* editorialized that M.I.T. "must begin to investigate seriously alternative sources of revenue . . ."

While The Tech*'s cartoon character Stickles and friends (the creation of Geoffrey Baskir) were making the best of it,* The Tech*'s editors responded to M.I.T.'s 10.6 percent tuition increase for 1983-84 (to $9,600) with a survey: Wellesley tuition will be up 15.1 percent to $8,550, Chicago 13.4 percent to $7,935, Tufts 11.6 percent to $8,534, Harvard 10.3 percent to $9,035, Princeton 12.8 percent to $9,450, Brown 11.5 percent to $9,200, and Stanford 9.8 percent to $9,027.*

Knowing that tuition would be officially set by the M.I.T. Corporation on March 3, the Undergraduate Association made plans for a "spontaneous tuition riot" that afternoon. President Ronald Reagan and Senator Gary W. Hart declined to come, despite the UAP's argument that their presence would "focus attention on the plight of our nation's students." The principal speaker, Connecticut Congressman Bruce A. Morrison, '65, laid the problem at Mr. Reagan's door: federal and state governments, he said, should join in a unified effort to "open the doors (of post-secondary educational institutions) to the people on the basis of their ability to contribute to society at large." Later students marched to the President's House chanting "Two four six eight can't afford to pay!" and "No way, we won't pay!" but the session in front of the house was marked by good humor and understanding. At the end of the day, John McLoughlin, '84, wrote *The Tech* what he had learned: "Maintaining your integrity as a student requires that you let somebody know what you think about all of this. . . . I'm about to write letters to my mother and my Congressman to ask them both for money."

Anaheim Computer Reception

Alumni attending the national computer conference of the American federation of Information Processing Societies in Anaheim, Calif., May 16-19 will be hosted at a reception (cash bar) on Monday, May 16, in the Garden Room of the Hilton-on-the-Park Hotel. For further information: Paul Hoffman, '79, telephone (415) 841-9284.

AOC September 23-24

The 1983 Alumni Officers' Conference—renamed the National Alumni Conference, but with a format similar to recent AOCs—will be held in Cambridge on September 23 and 24. The schedule calls for workshops on alumni activities—class, club, and fund-raising programs—on Friday afternoon, major reports of alumni and M.I.T. activities on Saturday, and a reception hosted by President and Mrs. Paul E. Gray at the end of the day on September 24.

Deceased

Frederick W. Lyle, '08; June 1981; 9757 S Turkey Creek Rd., c/o Eastman, Morrison, Col.
Carl H. Lovejoy, '10; December 28, 1982; 2150 SW 10th Ct., Bldg. 8-225, Delray Beach, Fla.
G. Arthur Brown, '11; October 31, 1982; 9001 Allentown Rd., Fort Washington, Md.
Walter C. Wilson, '11; December 21, 1982; Ferncroft Tower Apt. 709, Danvers, Mass.
Ora M. Merry, '12; November 14, 1982; Tower Hill Apts. #702, 810 SE Thornton, Minneapolis, Minn.
Ned Osthaus, '12; August 1981; 330 Wheeler Ave., Scranton, Penn.
Waldo F. Pike, '15; February 16, 1983; 86 Irving St., Cambridge, Mass.
Clifford E. Sifton, '15; May 30, 1981; RD 3 Box 277, Hillsborough Rd., Belle Mead, N.J.
Ralph A. Fletcher, '16; February 11, 1983; Joppa Hill Rd., RFD #2, Manchester, N.H.
Andrew C. Witherspoon, '16; May 26, 1982; 8400 Vamo Rd. #311, Sarasota, Fla.
Ernest E. Gustin, '17; January 19, 1983; 63 Pleasant St., Concord, N.H.
Samuel P. Crotwell, Jr., '18; November 3, 1982; RT 1, Box 86, Cordele, Ga.
Hosmer C. Jones, '19; January 17, 1979; 60 Nehantic Trail, Old Saybrook, Conn.
Sarkis M. Madancy, '19; July 30, 1972; 33 Stowecraft Rd., Arlington, Mass.
Lansing M. Quick, '19; July 1979; 2108 White Way, Birmingham, Ala.
James C. Sansberry, '19; January 12, 1981; 101 W 10th St., PO Box 309, Anderson, Ind.
Leon A. Lloyd, '21; January 13, 1983; 35 Spruce St., Westerly, R.I.
Eugene E. Rudow, '21; November 26, 1982; 46181 Highway 74, Palm Desert, Calif.
Waller V. Morgan, '22; November 15, 1982; c/o Mrs. A. Nelson, 6337 Gaywind Dr., Charlotte, N.C.
George E. Taylor, '22; 1982; 1715 Monmouth Dr., San Diego, Calif.
J. Allan Abbott, '23; November 25, 1982; 251 Dogwood Ln., Stamford, Conn.
Bernardo Elosua, '23; January 1979; 5 De Mayo 110, Pte San Pedro, Garza Garcia NL, Mexico.
Richard C. Kleinberger, '23; January 1983; 4 Birchwood Rd., White Plains, N.Y.
Charles H. Tirrell, '23; October 20, 1982; 46 North Rd., Waterford, Conn.
Harold Van Buren, '23; January 28, 1983; 22 Harbor Rd., Harwich Port, Mass.
George B. Will, '23; June 25, 1982; 71 Craigemore Circle, Avon, Conn.
Frederick E. Terman, '24; December 19, 1982; 445 El Escarpado, Stanford, Calif.
Otto R. Richter, '25; December 20, 1982; 940 Sweetwater Ln. #202, Boca Raton, Fla.
Arthur J. Brockelman, '26; November 23, 1982; Fairlawn Nursing Home, 370 West St., Leominster, Mass.
Frank W. Gratz, '26; September 13, 1982; 15 Bishop Place, Larchmont, N.Y.
George H. Reith, '26; 1982; PO Box 89, Bellvale, N.Y.
David Anson Rosenthal, '27; November 14, 1982; 235 E 73rd St., Apt. 9C, New York, N.Y.
Lawrence B. Whit, '27; August 22, 1982; 1571 Wealthy SE, Grand Rapids, Mich.
D. Yancey Bradshaw, '28; October 26, 1980; 74 Valley Rd., Larchmont, N.Y.
Thomas J. Murphy, '28; September 18, 1982; Box 695, Livingston, Mont.
Allan L. Tarr, '28; November 21, 1982; 337 Wassona Dr., PO Box 521, Marion, Va.
Theodore S. Alexieff, '29; December 26, 1982; 19914 Seventh St. East, Sonoma, Calif.
Walter S. Bennett, '29; January 22, 1983; 5 Belvidere Rd., Falmouth, Mass.
Sarto J. Nadeau, '29; July 1980; 3461 E Blvd. Gouin, Montreal North 459, PQ, Canada.
Franklin P. Nicholson, '29; November 27, 1981; 7704 Palm Dr., Holmes Beach, Fla.
John P. Tillinghast, '31; December 15, 1982; 4215 Gulf of Mexico Dr., Longboat Key, Fla.
Christian E. Grosser, '32; January 17, 1983; 214 Sleepy Hollow Rd., Richmond, Va.
C. Wallace Bohrer, '33; May 28, 1982; 3623 Patterson St. NW, Washington, D.C.
John Ostlund, '35; December 16, 1982; 292 NE 114th St., Miami, Fla.
Paul C. Panagiotakos, '35; February 27, 1983; PO Box 205, North Chelmsford, Mass.
Irving S. Underhill, '38; January 2, 1983; c/o Mrs. John Fegela, 617 Union St., Portsmouth, N.H.
Charles D. Robson, '41; August 1982; 414 Argonne Dr., Durham, N.C.
A. De Bretteville, Jr., '42; July 19, 1982; 224 Navesink Ave., Highlands, N.J.
James Robert O. Downing; '42, December 31, 1982.
Nicholas Glyptis, '44; July 30, 1982; 240 Forest Trail Dr., Oak Brook, Ill.
Allan B. Porson, '44; May 19, 1982; 20 Bridle Path, Sherborn, Mass.
Shiou C. Sun, '45; November 16, 1981; 213 W Mitchell Ave., State College, Penn.
Paul W. Barcus, '48; December 8, 1982.
Clarence R. Jacobson, '48; December 25, 1981; 149 Mt. Arlington Blvd., Landing, N.J.
Arnet L. Powell, '52; November 23, 1982; 65 Woodridge Rd., Wayland, Mass.
Nicholas Vytlacil, Jr., '55; October 1982; 3800 Falconer Dr., Soquel, Calif.
Luis Unikel Spector, '58; January 25, 1981; UVAS 32-1, Colonia Del Valle, Mexico, DF, Mexico.
Dimitri D. Afonsky, '59; September 29, 1980.
Richard D. Mattuck, '59; May 1982; Gisselfeld Alle 5, 2820 Gentofte, Denmark.
John B. Scouller, '61; August 4, 1982; c/o Mary S. Nelson, PO Box 37, North Granby, Conn.
Robert L. King, '68; November 1982; 3320 Bridge View Isle, Alameda, Calif.
Nancy J. Bryg, '74; October 4, 1982; 49 Showers Dr. #209, Mountain View, Calif.
Bruce V. Waddell, '74; 1979; 318 Brentford Ct., Louisville, Ky.
James H. Fifield, '76; March 1981; 172 Goodale Dr., Newington, Conn.

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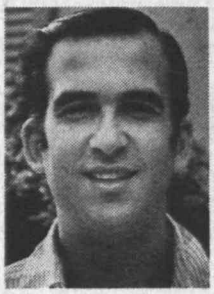


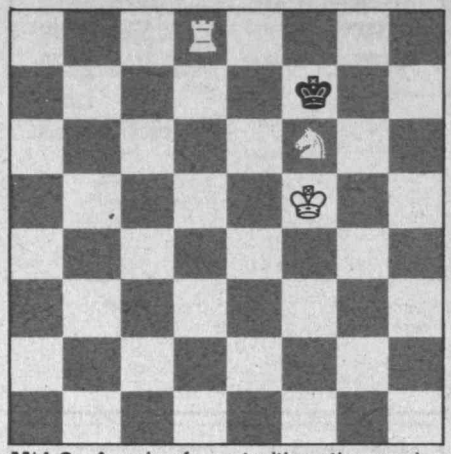
Allan J. Gottlieb, '67, is associate research professor at the Courant Institute of Mathematical Sciences of New York University; he studied mathematics at M.I.T. and Brandeis. Send problems, solutions, and comments to him at the Courant Institute, New York University, 251 Mercer St., New York, N.Y. 10012.

As promised last issue, here's a description of how we choose solutions for publication.

As responses arrive during the month, they are simply put together in neat piles, with no regard to their date of arrival or postmark. When it is time for me to write the column, I first weed out erroneous and illegible solutions. For difficult problems, this may be enough; the most publishable solution becomes obvious. Usually, however, many responses still remain. I next try to select a solution that supplies an appropriate amount of detail and that includes a minimal number of characters that are hard to set in type. A particularly elegant solution is, of course, preferred. I favor contributions from correspondents whose solutions have not previously appeared, as well as solutions that are neatly written or typed, since the latter produce fewer typesetting errors.

Problems

M/J 1. Given the diagram at the top of the next column, John Cronin wants White to move and mate in four.



M/J 2. Frank Rubin sent us an "infinitely hard" problem:
Differential equations crop up frequently, usually first order, but sometimes second order, rarely higher. For *Review* readers, though, we go right to the limit: Find a non-trivial, continuous, real-valued function f(x) possessing continuous derivatives of all orders, and satisfying the *infinite-order* differential equation
$f = f' + 4f'' + 9f''' + 16f'''' + \ldots$.

M/J 3. A pair of cryptarithmetic puzzles from Thomas McNelly:

$$\frac{\text{EVER}}{\text{NNNNN}} = .\text{ONANDONANDON} \ldots$$

$$\frac{\text{EVER}}{\text{VVVVV}} = .\text{ONANDONANDON} \ldots$$

$$= \frac{\text{IRIS}}{\text{IIII}}$$

M/J 4. Larry Bell asks us about consecutive primes:
Find three consecutive three-digit prime numbers x, y, z, such that $z - y = y - x = 12$. In other words, there are no prime numbers between x and z, other than y. Find four consecutive three-digit prime numbers a, b, c, d, such that $d - c = c - b = b - a = 6$. What is the largest string of consecutive primes $P_1, P_2, \ldots, P_n$ such that:
$P_n - P_{n-1} = P_{n-1} - P_{n-2} = \ldots = P_2 - P_1 = 4$.

M/J 5. Harry Zaremba notes that for any triangle, the ratio of the sum of the squares of the medians to the sum of the squares of the sides equals a constant rational number. What is this number?

Speed Department

M/J SD1. We end with a problem from Phelps Meaker:
To build a straight sidewalk 54'8" long, there is a pile of 40 cast-concrete slabs, formed as equilateral triangles. To square off the ends, two extra 30°-60° half-slabs are provided. What is the width of the walk?

M/J SD2. A birthday quickie from John Linderman:
On my birthday this year, my age was *not* the product of exactly two primes. However, for a few previous birthdays in succession, it had been. What is the largest number of successive birthdays on which your age can be the product of two primes? Given that I just went past the first such maximal sequence, how old am I? If I live to be 100, how many such maximal sequences will I celebrate?

Solutions

JAN 1. Unfortunately, the proposer has written that his original analysis was in error and the problem should be withdrawn. Richard Hess and Doug Van Patter noticed that, in fact, only those declarers making the *wrong* play at trick 5 took 11 tricks.

JAN 2. On a map of Massachusetts, each town is connected to its nearest neighbor (assume no ties). Show that no town is connected to more than five others.

Daniel Seidman solved this problem by making two key observations. First, since there were no ties, any three cities form a scaline triangle (i.e., all sides lengths unequal) and thus the longest side would not appear on the map. Second, for a city A connected to six or more others there must exist two neighbors B and C such that angle BAC is less than or equal to 60°. Now it's easy. Triangle BAC has angle sum 180° (or greater if on the globe), so the largest angle cannot be BAC and hence either line AB or AC does not appear.

Also solved by Avi Ornstein, Leo Harten, Naomi Markowitz, and Richard Hess.

JAN 3. Drill a hole through a solid sphere (along a diameter) whose radius is such that the height of the remaining ring is two inches. Find the volume of the ring.

The following pair of solutions is from Avi Ornstein:

Let the radius of the sphere be R. The height of the missing sections of the sphere (top and bottom) is R − 1. The cylindrical hole has a radius which is one side of a right triangle, with 1" as the other side and R as the hypotenuse.

The volume of the sphere is $4\pi R^3/3$.

The volume of the cylinder is $\pi r^2 h$, or $\pi(R^2 - 1)2$.

Each segment of the sphere is

$\pi h^2(3r - h)/3$, or $\pi(R - 1)^2(2R + 1)/3$.

The volume of the ring is therefore

$4\pi R^3/3 - (2\pi R^2 - 2\pi) - 2(2\pi R^3/3 - 2\pi R^2 + \pi/3)$

or $4\pi/3$ in^3.

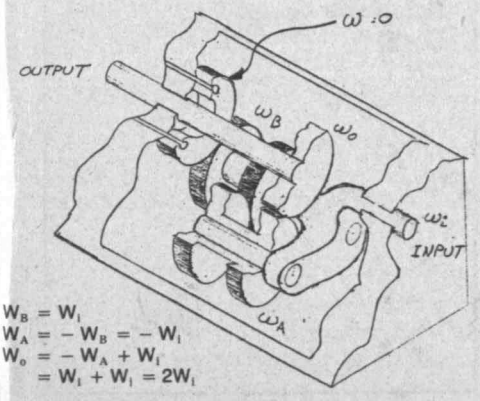
If the original sphere had a diameter of 2", the hole would be nonexistent, and the volume of the sphere would give the same answer, as an alternate way of solving the problem.

Also solved by Phelps Meaker, Ken Haruta, John Prussing, Frank Carbin, Daniel Seidman, Ronald Raines, James Reswick, Fredrick Hutchinson, Richard Hess, Harry Zaremba, Naomi Markowitz, Norman and Ammi Spencer, Roger Milkman, Norman Wickstrand, Richard Marks, Emmett Duffy, Leo Harten, David Evans and the proposer, Dean Edmonds.

JAN 4. In building a model, a man found that he needed a 2:1 gear ratio. He had on hand only six equal gears (like those shown below), yet he was able to obtain the desired ratio, using full tooth conventional meshing. How?

A beautifully drawn solution shown at the bottom of the previous column was submitted by Floyd Kosch.

Also solved by Richard Marks, Emmett Duffy, Chuck Coltharp, Richard Hess, Luigi Burzio, and James Reswick.



$W_B = W_I$
$W_A = -W_B = -W_I$
$W_o = -W_A + W_I$
$= W_I + W_I = 2W_I$

Better Late Than Never

Y1982. Responses received from Robert Sackheim and Harry Garber.

A/S 2. Richard Hess has found a solution if we are not restricted to bishop moves.

OCT 2. Hillary Fisher and R. Morgan believe that, for example, the sum TWELVE × 2 indicates that the value for TWELVE should be half the sum. Their solutions are

13744	645
64948	75054
64948	75054
64948	75054
208588	75054
= 104294 × 2	375915
	= 125305 × 3

84502	5394
84502	5394
68387	24947
68387	24947
68387	24947
818387	24947
1192552	404947
= 298138 × 4	404947
	920470
	= 184094 × 5

OCT 3. Nancy Everds believes the cone contains hot fudge and the sphere is ice cream. Thus melting must be considered.

OCT 4. Steve Chilton does not believe that a solution involving Bessel functions (or any other series-defined functions) should be considered closed form.

OCT 5. Jordan Wolk submitted an alternate solution.

N/D 2. Harry Garber and Leo Harten have responded.

N/D 3, N/D 4. Leo Harten has responded.

N/D 5. Harry Garber, Leo Harten, and William Stein have responded.

1983 JAN SD2. Ken Fawcett believes that Van-Patter's line of play is reasonable but not guaranteed to succeed.

1983 F/M SD1. L. Steffens and Jordan Wolk noticed that it is the lock that is 10 by 30 feet.

Proposer's Solutions to Speed Problems

SD 1. 27.733"

SD 2. Three in a row. If two of the years were even, one would be divisible by 4. Since 4 is flanked by 3 and 5, 4 itself cannot participate in the sequence, and neither can 4× anything else. The "middle number" in such a sequence must therefore be 2 × p for some prime p. Browsing around for such numbers flanked by the product of two primes, one first hits paydirt at p = 17, with

33	34	35
3 × 11	2 × 17	5 × 7

So I am (indeed) now 36 (a perfect square, someone insisted on pointing out). Others (I hope I didn't miss any) are:

p = 43 5 × 17 = 85 2 × 43 = 86 3 × 29 = 87
p = 47 3 × 31 = 93 2 × 47 = 94 5 × 19 = 95

So it looks like three by 100.

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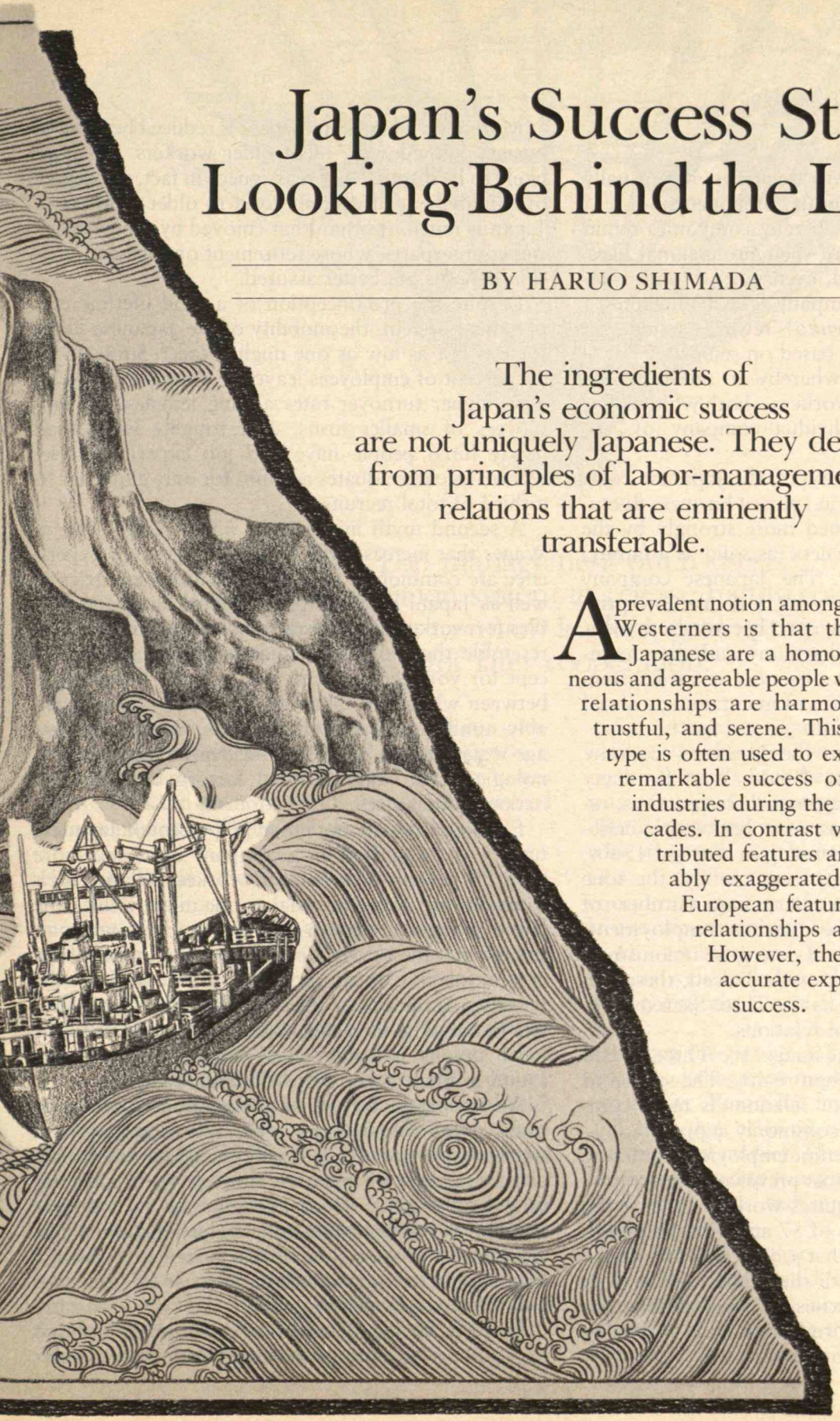


Japan's Success Story: Looking Behind the Legend

BY HARUO SHIMADA

The ingredients of Japan's economic success are not uniquely Japanese. They derive from principles of labor-management relations that are eminently transferable.

A prevalent notion among Westerners is that the Japanese are a homogeneous and agreeable people whose relationships are harmonious, trustful, and serene. This stereotype is often used to explain the remarkable success of Japanese industries during the last two decades. In contrast with these attributed features are the comparably exaggerated American and European features of adversarial relationships and individualism. However, there are other, more accurate explanations for Japan's success.

The Three Sacred Treasures

Japanese labor-management relations are usually seen to have three conspicuous components:

☐ Lifetime employment, whereby companies retain workers for the duration of their professional lives. Workers are not dismissed, even when business activity declines, unless a company faces bankruptcy.

☐ A length-of-service (*nenko*) reward system, in which salary increases are based on seniority.

☐ Enterprise unionism, whereby a union is organized to serve only the workers—both white-collar and blue-collar—of an individual company (or "enterprise").

According to these stereotypes, the Japanese company retains its employees in spite of business fluctuations because it is governed more strongly by the principle of group cohesiveness (as solid as a family) than economic sensitivity. The Japanese company can enjoy industrial peace with a docile enterprise union as a bargaining counterpart because both management and labor desire harmony and share common goals. And the length-of-service reward system serves the important function of maintaining a social order.

During the 1950s, when the Japanese economy was still recovering from World War II, many Japanese scholars argued against these practices, regarding them as symptoms of a backward, undeveloped capitalism. But beginning in the mid-1960s, when the economy was growing rapidly, the tone changed remarkably. An increasing number of Japanese began to praise lifetime employment, length-of-service rewards, and enterprise unionism as contributing to economic growth. Indeed, these factors were often referred to as the Three Sacred Treasures of Japanese industrial relations.

But despite their popular image, the Three Sacred Treasures are more myth than reality. The system of Japanese labor-management relations is more complex and less unique than commonly supposed.

Consider the so-called lifetime employment practice. In large firms, where it is most prevalent, the compulsory retirement system requires workers to leave the company between the ages of 57 and 60. Most work for several more years in other jobs, which are usually casual and lower paid, until they finally retire from working life in their late sixties. In other words, even the most privileged large-firm workers do not enjoy completely sheltered employment.

Moreover, when employment is reduced because of business slowdowns, these older workers are more likely to be dismissed or reassigned. In fact, the degree of employment protection given to older workers in Japan is much less than that enjoyed by their American counterparts, whose retirement options and pension benefits are better assured.

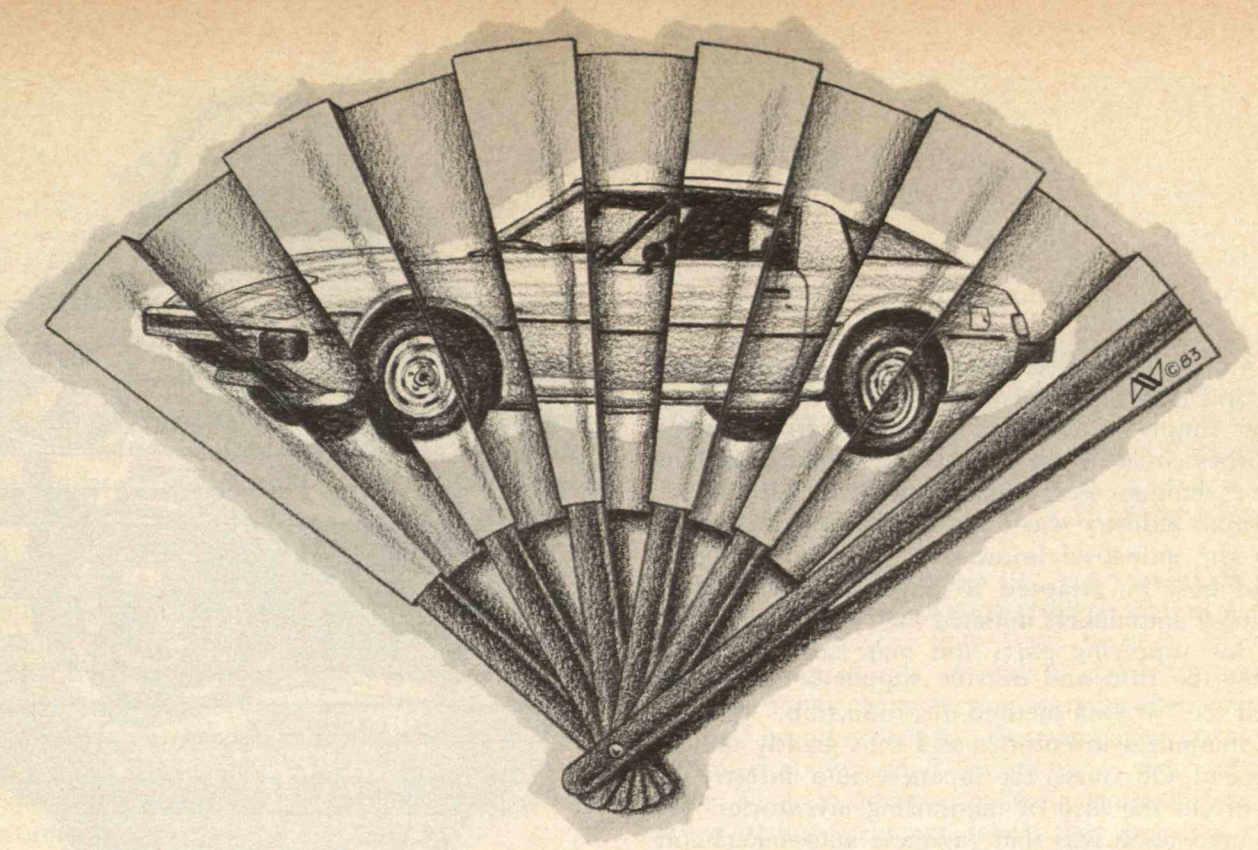
Despite the preconception of a rigid lifetime employment system, the mobility of the Japanese labor force is not as low as one might expect. Some 10 to 20 percent of employees leave their firms every year, with higher turnover rates among females and employees of smaller firms. And roughly half of all newly hired people have had job experience elsewhere; recent graduates account for only a quarter to a third of total recruits.

A second myth involves the *nenko* wage system. Wages that increase with length of service or experience are common in other industrialized countries as well as Japan. For example, Japanese age-wage profiles for workers of different educational levels closely resemble those of their American counterparts, except for younger workers. And relative differentials between white- and blue-collar workers are remarkably similar in the two countries, suggesting that age-wage profiles are determined primarily by technological and organizational factors, regardless of national differences.

Finally, although more than 90 percent of Japanese unions are organized on a company basis and more than 80 percent of unionized workers belong, their functions are not as unusual as one might think. The law that regulates union activities in Japan was patterned after the U.S. labor-relations law. In fact, if the critical function of enterprise unions is to improve the working conditions of their members through collective bargaining, then the unions are equivalent to the local unions or plant-level worker organizations found in many other industrialized countries.

An important feature of Japanese industrial relations in individual firms is the way managers and worker representatives, usually including union officials, exchange information through joint consultation. This system, which encompasses such diverse matters as management policies, production plans, working conditions, and fringe benefits, is distinct from collective bargaining; its purpose is discussion and information sharing only.

In 1977, the Japanese Ministry of Labor found that of 5,000 private enterprises with 100 or more regular



Top management often uses the joint-consultation system to release highly confidential information to union leaders, paving the way for later cooperation.

employees, more than 70 percent had such consultation systems. Other surveys reveal that the system is more prevalent and better defined among larger firms. A related phenomenon is that more unionized than nonunionized firms use such a system.

High Quality at Low Cost

In propounding the conventional cultural explanations of Japan's industrial success, observers tend to overlook the critical period preceding Japan's recent growth. While data on Japan's economy were relatively abundant during the late 1940s (when Japan was occupied and controlled by the Allied Forces) and after the mid-1960s (when the economy gained attention because of its phenomenal growth), outsiders generally know very little about what happened during the 1950s. But this was the gestation period for Japan's subsequent success, when the country initiated a strategy of "rationalization"—consolidating and coordinating industries to eliminate excessive competition and promote exports. The strategy included increasing technical know-how to improve product quality, developing cooperative labor-management relationships, and instituting information-sharing systems.

An outstanding example of investing for rationalization was the first five-year plan of the Japanese steel industry, which began in 1951. When the plan was completed, major steel corporations had established integrated mass-production systems complete with strip mills. By the end of the second rationalization plan, the steel industry had modernized its equipment even further. And by the late 1950s, large-scale investment and technological innovation, much of it borrowed, had begun in other key industries as well, including electric power, shipbuilding, petrochemicals, automobiles, and electrical equipment.

During this period, Japanese industrial policymakers agreed that their most important goal was product quality. Producing high-quality goods at reasonable cost, they believed, was the key to success in the international market. The target was pursued by earnestly introducing foreign technological and managerial know-how and massively investing to attain rationalization.

Determined to learn industrial-engineering techniques from the United States and Europe, corporations continually sent their engineering and managerial staffs over seas. Examples of such "technology transfer" include the assistance Armco Steel gave to

Fuji Co., General Electric to Toshiba, Austin to Nissan, and Philips to Matsushita.

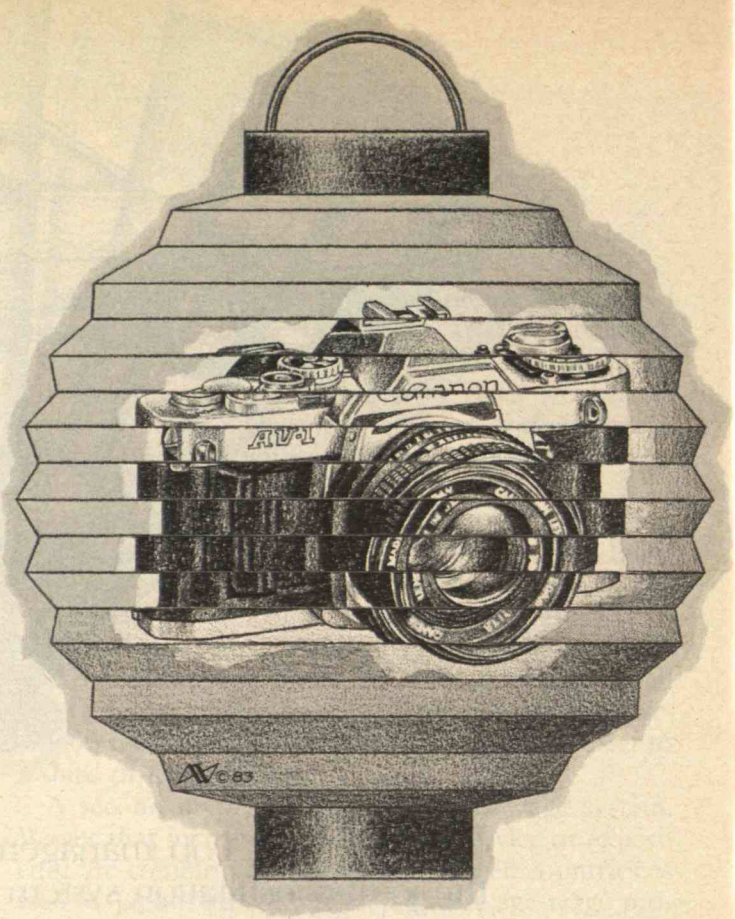
But simply introducing techniques from foreign countries could not alone improve production; how such techniques were implemented was also critical. The auto industry was one of the first to determine how the industrial know-how of other countries could best be adapted to Japanese production. Japanese automakers initiated the "just-in-time" system for supplying parts and materials both from within the firm and outside suppliers. Sometimes called the "Toyota method of production," this system minimizes inventories and thus greatly reduces overhead. Of course, the Japanese auto industry did not invent the idea of minimizing inventories. The real innovation was that Japanese automakers constructed a network of subcontractors and parts suppliers tailored to local needs.

Intensive Interactions

But these production principles, however brilliantly executed, weren't enough. Corporations also had to gain the understanding and cooperation of their employees as well as people in nearby communities. Efficient production could be attained only by fully utilizing both human and physical resources.

However, Japanese labor-management relationships until the mid-1950s, far from harmonious, were hostile and adversarial. In the years immediately following World War II, unions emerged almost spontaneously in most large and medium-sized enterprises. These unions pursued aggressive, radical strategies—often fanning labor disputes and demanding worker control of production—to secure benefits during the hyperinflation and economic disorder of the time. *Sanbetsu-Kaigi* (the Congress of Industrial Unions), formed in 1946 with Communist initiative, quickly gained leadership in organizing radical actions in various economic sectors. Bitter disputes soon swamped almost every major industry. Strikes were frequent and often of several months' duration.

But in the mid-1950s the labor movement began to change. Antagonism and confrontation among factions of workers during the prolonged and bitter struggles reached critical proportions. Leftist labor leaders grew even more radical, but rank-and-file workers were skeptical about the usefulness of such dogmatic platforms, and a second kind of union began to gain popularity.



Although patterned after the American model, the Japanese supervisory system is different in one important respect: supervisors are promoted from the ranks of production workers.

During this time managers in industries such as steel, auto, and shipbuilding made conscious attempts to foster relationships with young workers and new labor leaders. These leaders admitted the necessity of planning cooperatively for the future, and managers aided their organizing activities. Although this process was by no means free of bitter struggles and painful experiences, the new labor leaders gradually took control.

For example, after two strikes in the steel industry in 1957 and 1959 failed to win workers any concessions from management, the federated steel union's leftist leaders gave way to the more realistic leadership of Yoshiji Miyata. As a result, many workers who had become disenchanted with earlier approaches began to support the new labor movements that began to penetrate many plants.

Signs of change were also apparent in the national labor organization. Four union federations criticized

Sohyo, the All-Japan General Council of Labor Unions, for its role in the strikes of coal miners and power-industry workers in 1952. This disagreement eventually led to the formation of a confederation of more moderate unions, the *Zeonro-Kaigi* (the All-Japan Congress of Unions). The top leadership of *Sohyo* also shifted in the elections of 1954 and 1956 from Minoru Takano, who emphasized community action, to Kaoru Ohta and Akira Iwai, who advocated economic unionism and proposed Spring Labor's Wage Offensive—concerted labor negotiations centering around the issue of wage hikes.

The new labor-management relations promoted by these leaders, particularly at the level of the firm and the shop floor, allowed intensive and productive interactions to take place.

Open Communication

Three labor-management devices common today in successful Japanese industries typify the improved relationships formed in the 1950s. These include the joint-consultation system, the role of first-line supervisors, and the quality-control (QC) circle.

The *joint-consultation system*, an important communication link between management and labor, enables representatives of both sides to discuss a broad spectrum of issues from investment and production plans to housing allowances. Top management often uses the joint-consultation mechanism to release highly confidential information to union leaders. Their involvement at a relatively early state of decision making is thought to pave the way for later cooperation. In some cases, worker representatives respond to suggestions with their own plan, which may become part of management strategy.

This system was first introduced by management shortly after the war to counter the movement for worker control of production. But not until the mid-1950s did joint consultation start to restructure labor-management relations. The Japan Productivity Center, founded in 1955, was instrumental in promoting this trend.

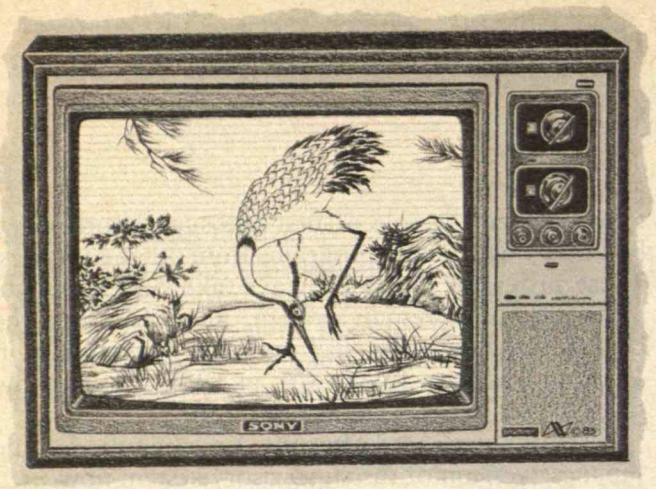
First-line supervisors are an important link between management and the rank-and-file because they are both low-level management and heads of production teams on the shop floor. The need to establish such a transitional step in the hierarchy became urgent in the 1950s as industries were rationalized. Business leaders made various attempts to strengthen the role of first-line supervisors, often by importing training programs from other countries. These programs did not always take root in Japan, although the foreman system, adopted from the United States into the steel industry (Yawata Co. in 1956 and Nippon Kokan Co. in 1959) was notably successful.

Although patterned after the American model, the Japanese version of the supervisory system now used is different in one important respect. Because Japanese supervisors are almost always promoted from the ranks of production workers after long service and broad experience, these managers are as well informed about actual operations as their subordinates. Thus, in addition to being intermediaries between management and labor, they are involved in routine shop affairs. In the United States, by contrast, the role of supervisors is limited, partly because many acquire the position without accumulating much production experience, and partly because their role as members of the management team receives more emphasis than their role as work-group leaders.

Quality-control circles, the final extension of the spirit of the joint-consultation and supervisor systems, uses the traits and talents of all members of a work team to optimize procedures on the shop floor. These circles also facilitate communication and information sharing among workers themselves.

The number of quality-control circles registered with the national headquarters of the QC-circle movement was still small at the beginning of the 1960s. But by 1970 the movement counted some 33,000 circles with 400,000 participants, and by 1980 included 115,000 circles with more than 1 million participants. The growth and success of such information-sharing systems during the past two decades were made possible by the structural reforms promoted in the "gestation" decade before.

Joint consultation, first-line supervisors, and QC circles are only a few examples of the communication that characterizes all levels of Japanese corporations. But instrumental in the effectiveness of these information-sharing systems is the Japanese pattern of job rotation and promotion from within. What makes this system of long-term employment and internal promotion unique is that workers achieve a breadth of occupational experience while serving one company. Production workers typically rotate through a much broader range of job assignments than their European or American counterparts.



The structure of labor-management relations built into the Japanese economy during the 1950s and 1960s is a monumental achievement in the industrial world.

Some analysts attribute this practice to the fact that many of Japan's leading corporations, which began by importing foreign technologies, had to foster skilled workers from within because the supply outside the firms was limited. Other observers emphasize the role of postwar social reforms in elevating the status of workers, who began to take their work, and its implications, more seriously. But regardless of the causes, the effects are profound: Japanese workers acquire a greater overall understanding of their companies' operations and products and thus have a better basis for contributing new ideas as well as communicating them.

A Transferable Achievement

Western observers often cite several additional factors to explain Japan's remarkable postwar industrial growth:

☐ The war's massive physical destruction provided Japanese industries with an opportunity to build newer and more productive facilities than those of their competitors.

☐ A young and well-educated labor force was abundantly available, owing at first to improved prewar secondary education and later the postwar baby boom.

☐ The lack of domestic resources provided industry with the incentive to look for inexpensive raw materials overseas.

In my view, although these factors contributed to the dynamic industrial growth of the 1960s, this growth would not have been possible without breakthroughs in labor relations. Indeed, without active, positive efforts on the part of both management and labor, these background factors may well have become hindrances.

The structure of labor-management relations built into the Japanese economy during the 1950s and 1960s is a monumental achievement in the industrial world. Thus, the Japanese "success" that attracts worldwide attention is neither luck nor a miracle but simply the result of this remarkable system. This experience suggests two important policy implications.

One is that such experiences are transferable. Because Japan's success was achieved through rational efforts to overcome a perceived crisis rather than predestined by cultural traits, the experiences can be shared with other countries. This sharing, however, should not be in the form of copying a superficial "management style" but in studying the Japanese decision-making process: how choices are made with the participation of all interested parties.

The other implication relates to Japan's future choices—the country's continued success is not automatically guaranteed. Indeed, in sharp contrast to relatively successful industries such as autos and electronics, basic material industries such as petrochemicals, aluminum, copper, paper, and pulp are already suffering from external changes, including increased energy costs. And industries that have acquired large shares of the world market may not do as well in the future without taking their impacts on other countries more seriously. For example, the United States and others have begun to retaliate by imposing protectionist measures against Japan, including import quotas and minimum-local-content laws. These countries have also been pressuring Japan to accept more manufacturing imports, especially in conjunction with imports of raw materials. Whether Japan can maintain its industrial strength will also depend upon whether Japanese society can adapt to new conditions such as an aging population, an expanding female workforce, and a shift from manufacturing to service jobs.

HARUO SHIMADA, Ph.D., is professor of economics at Keio University in Tokyo. This article is adapted from "Perceptions and Reality of Japanese Industrial Relations," presented in November 1982 at M.I.T.'s conference on "Effective Business Management: Lessons from Japan."

A Japanese Management Import Comes Full Circle

BY ROBERT E. COLE

Two years ago companies were scurrying to soak up information on the latest import from Japan: quality circles. By early 1982, according to a recent survey, there were 6,300 U.S. sites with quality circles. Suddenly, but predictably for anyone who has studied the fate of similar management fads, the "movement" has stalled.

Management seminars on quality circles are undersubscribed, and the more than 100 consultant firms offering services installing circles are scurrying for work. Program coordinators report they are increasingly on the defensive vis-à-vis their superiors. More significantly, quality circles have become dirty words in many companies, including many of those that were recently patting themselves on the back for their innovative approaches.

There are some obvious but only partial explanations for the drop in interest. Managers and workers tire of being told how the Japanese do everything better. Unions such as the Union of Electrical Workers and the International Association of Machinists have become more outspoken in their mistrust of management motivations for introducing circles. The downward cycle of the economy, with its spreading ripples of layoffs, has curtailed many innovative efforts.

One often hears from managers that once you label an innovative activity of this nature, you are, in fact, insuring its demise. Surely the overselling of circles as a panacea for worker-related and quality problems contributed to the cynicism of many managers.

Middle managers, their prerogatives threatened by quality circles, seize upon potential weak points to attack circles for loss of operating time, useless meetings, disruption of normal routine, and higher administrative costs. One program coordinator plaintively asked for help in responding to his vice-president's claim that "Why, it takes the circles three weeks to solve something I could do in three hours." The circles are becoming a symbol for "weak management." Such attacks on quality circles have been used to sidestep the real issue of sharing of power and decentralization of decision making.

For some unions, quality circles have become the label attached to quick-fix activities designed to involve workers superficially without union participation, while "quality of work life" is the label attached to more thoroughgoing efforts involving the union. One union official confided that his union needed that label "quality circle" in order to attack the "bad version" of small-group problem-solving teams. If it wasn't "quality circle," they would have had to invent another term to designate the target.

Quality circles are presented as nice clean packages. This has been their source of strength but also their weakness. As a source of strength, they appeared to management as a self-contained package with known costs and limits. They could, or so it seemed, be treated as a new machine that could be plugged into operations with a minimum of disruption in the organizational hierarchy. The weakness was that this image of a nice clean package left management ill-prepared for the changes in reward systems and middle management's operating style that are necessary for circles to take hold and survive.

If the issue is, as I suggest, one of sharing of power and the decentralization of decision making, what strategies are available to overcome the above problems?

First, there needs to be a transition from the narrow focus of quality circles to more broad-gauged participation on the shop and office floor. There are a variety of ways in which workers can be involved in everyday decision making that go well beyond quality circles. Circles must be part of the effort to build cooperative action in the organization but can't be the sole driving force. In unionized firms, the union must be brought in as a full partner to give credence to the decentralization effort.

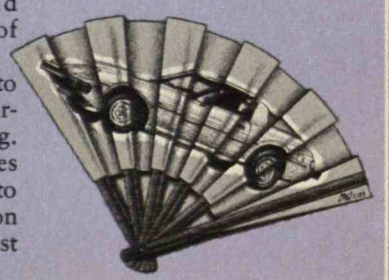
Second, the circles will make more valuable contributions if they are linked tightly with current management objectives. This is more likely to happen if circles become a line responsibility rather than remaining a staff assignment. In some manufacturing companies, the circles are being tied closely to the installation of just-in-time delivery systems—still another Japanese import. To avoid the disruptions arising from reduced inventories, the circles are involved in solving the problems creating the bottlenecks. In still other companies, the circles are focusing more directly on newly elevated quality-improvement objectives. In one company, this takes the form of preventive problem-solving groups. Such linkages can be effective in broadening, reinvigorating, and deepening the commitment of all parties.

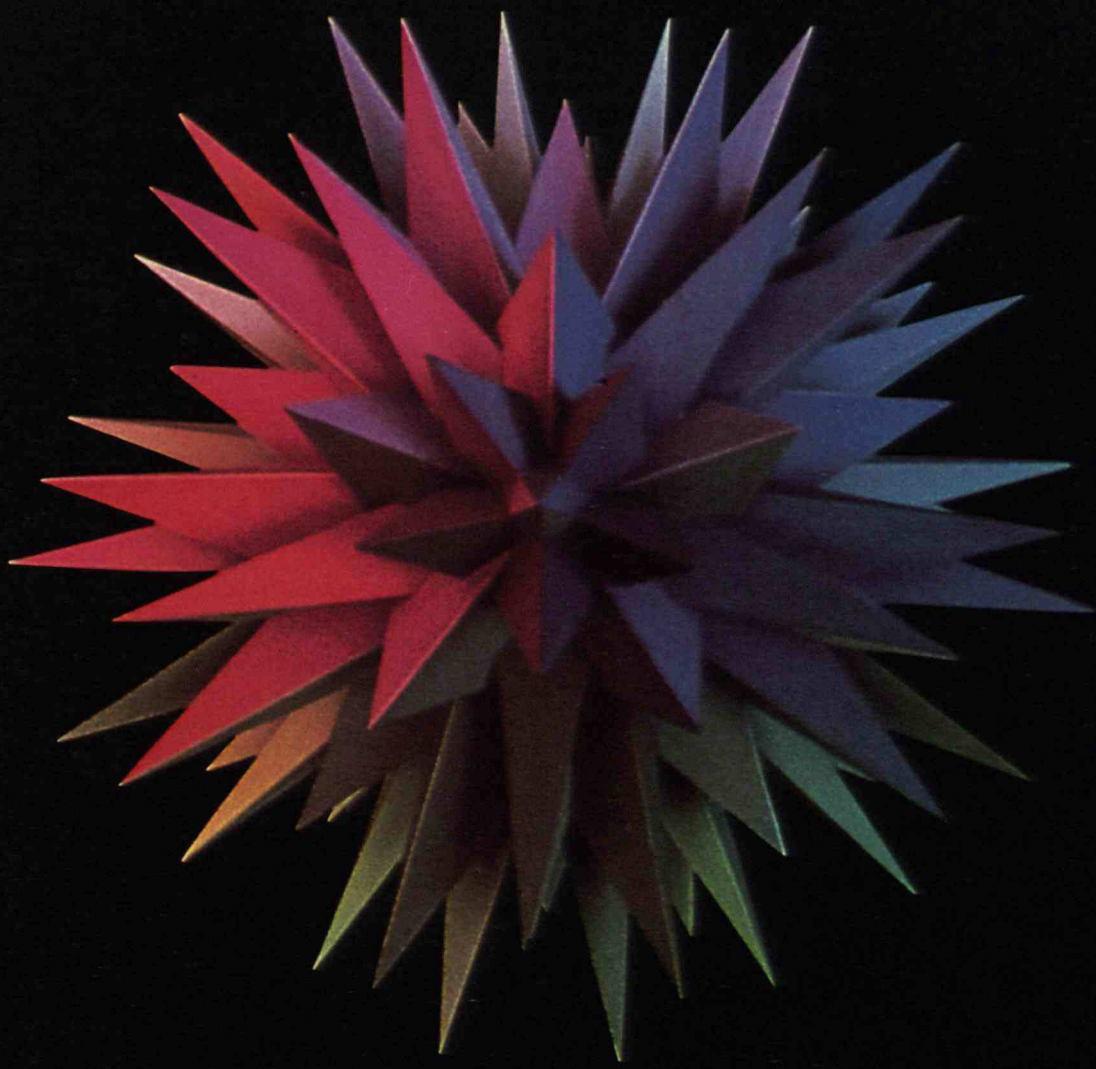
A third element critical to the long-term success of circles is information sharing. Shop and office employees need raw data if they are to solve problems; information sharing also encourages trust among employees.

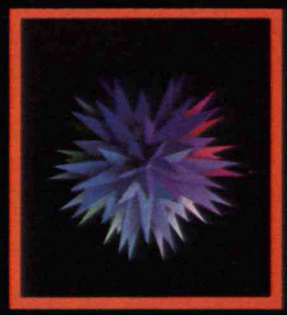
It is significant in this regard that relatively few of the Japanese firms operating in the U.S. have adopted quality circles. Matsushita Electric, which has run the Quasar plant in Chicago for several years, only recently introduced circles. The Japanese managers make clear that they need lengthy preparation to lay a firm foundation based, to a great extent, on information sharing. Yet many U.S. firms have adopted circles without any thought to the matter. Warranty data, production data, and scrap data are typically available in a manufacturing plant. But how often are they made available in a timely fashion and in a form usable for shop-floor workers?

Many firms will end up rejecting this import. In so doing, they will fail to grasp the significance of the full utilization of human resources that is so much at the heart of the Japanese decentralization effort. The answer to the vice-president who says he can solve the problem in three hours instead of three weeks: "Your solution will be gone in three months but the circle's solution will endure!" □

ROBERT E. COLE is professor of sociology and project director of the Joint U.S.-Japan Automotive Study at the University of Michigan.







"Composite of Three Star Forms," by sculptor Morton C. Bradley, is colored with an even progression of the hues of the spectrum and the shades from light to dark. As the sculpture turns, different combinations of color burst into view, some seeming to appear in bright swatches, others more subtly diffused.

Predestined Sculptures

Plato said the universe was made of geometric solids–bad physics but inspired art.

BY JONATHAN SCHLEFER

A cluster of geometric star forms—a constellation of great stellated dodecahedra to those who like rolling impressive words off the tongue—is arrayed in colors as prodigal yet rational as nature itself. On a winter day, in an artist's bare studio lit through large windows by sunlight and reflections from the snow, the star cluster revolves slowly, and all the seasons of the year seem on parade. Yellows, blues, and greens are like mid-summer foliage. But soon that form appears to vanish, while a new one—similar yet utterly transformed—flares up in oranges, reds, and browns. And just as this begins to grow familiar, one is startled yet enthralled by lavenders, purples, and crimsons.

Sculptures such as this by Morton C. Bradley, Jr., are based on strict mathematical shapes and color schemes. The sculptures are exciting yet hypnotic. They are orderly, yet one wonders how. And in the strangest transmutation of all, the mathematical relationships of color and form can grow into meaningful configurations: some of the sculptures are nicknamed trees, Machiavellian knots, and angel wings.

Mathematics and Mysticism

Bradley's sculptures, which were on exhibit at M.I.T.'s Compton Gallery this past February and March, are based on geometries of the so-called "Platonic solids"—the only convex solids with regular faces. These are the tetrahedron with 4 triangular faces, the cube with 6 square faces, the octahedron with 8 triangular faces, the dodecahedron with 12 pentagonal faces, and the icosahedron with 20 triangular faces. Their geometries are amazingly fertile, and their origins, which go back almost to prehistory, stem equally from mathematics and mysticism.

The early Greeks, a good starting point in the story of the Platonic solids, thought the gods were knavish, death was a shadow play, and one had best concentrate on the here and now. "Better a slave on earth than king of Hades," said the disgruntled ghost of Achilles in Homer's *Odyssey*. But that pessimism gradually gave way to a new faith based on—of all things—mathematics.

Greek mathematicians constructed the edifice of Euclidian geometry, solved algebraic equations, and explored

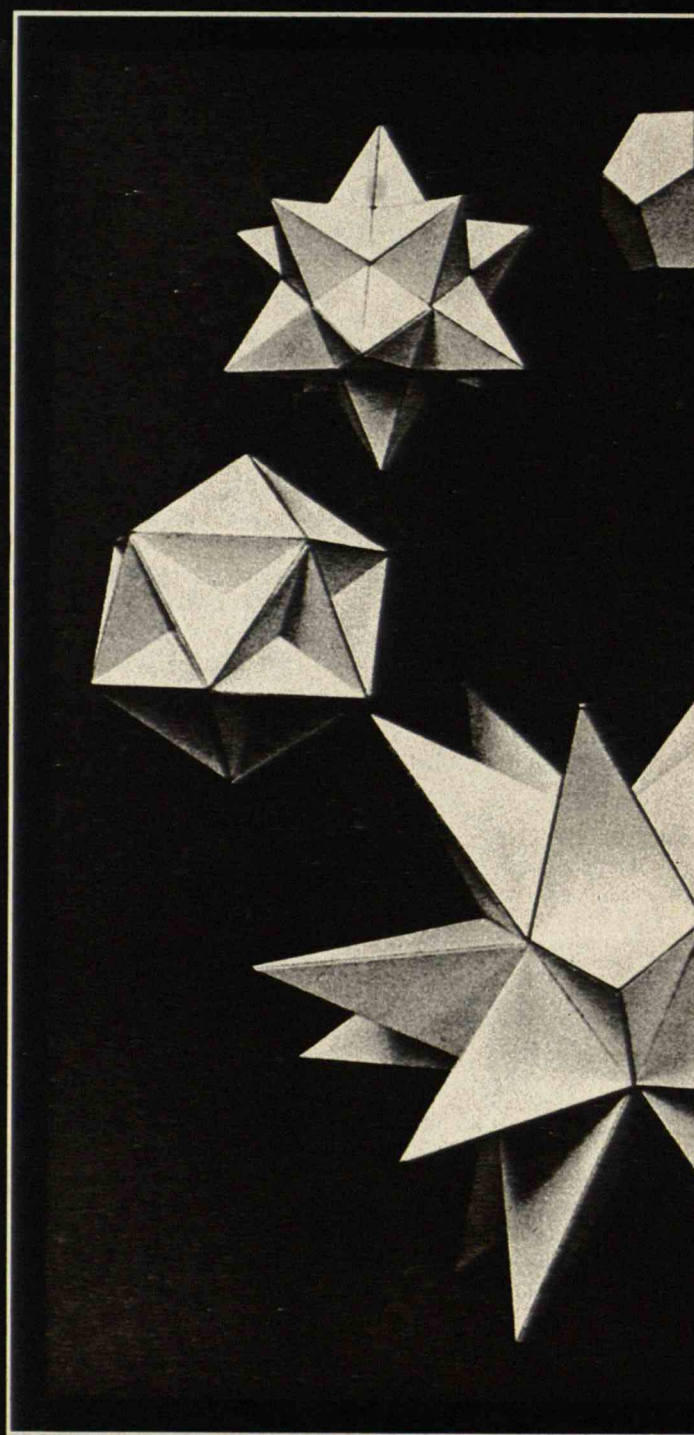
trigonometry. The Greeks discovered that mathematics underlay surveying, navigating, commerce, construction, design, and even music. For example, a little before 500 B.C., Pythagoras, a mystic philosopher who lived in a Greek city in what is now southern Italy, discovered not only mathematical theorems but also the importance of numbers in music. Cutting a vibrating string to half its length makes it an octave higher; cutting it to two-thirds of its length makes it a fifth higher; cutting it to three-quarters of its length makes it a fourth higher. Pythagoras and his followers saw mathematics as the basis of science and aesthetics. He said, "All things are numbers."

Writing more than a century later, Plato continued the Pythagoreans' line of thought. At a time when Athens was losing its eminence, he saw immortality in mathematics. When time had laid waste to marble monuments, logic—and an ideal existence that this world only dimly reflected—would stand secure. To Plato it was this physical world that was a shadow play, enacted in a cave and illumined by a dim flame. But because the human spirit can intuit the ideal, it must share somewhat in immortality. When St. John wrote in *The New Testament* that in the beginning was the Word (*logos*) and the Word was God, he echoed Plato. *Logos* in Greek meant word, reason, idea—it conjured up Plato's whole mathematical perfection.

As perfect building blocks, Plato proposed the five regular solids—hence they are called the Platonic solids. The Pythagoreans probably knew about these solids, according to Sir Thomas Heath in his authoritative *History of Greek Mathematics*, but Plato established their place in history, describing them in *Timaeus*. Of all his books this was the only one translated into Latin and kept alive during the Middle Ages. *Timaeus* played an important part in upholding a vision of perfection in thought and art.

According to Plato, four of the regular solids formed particles of the ancients' elements: the 4-sided tetrahedron formed particles of fire, the 6-sided cube particles of earth, the 8-sided octahedron particles of air, and the 20-sided icosahedron particles of water. These solids have faces that are either triangular or square, and squares are merely two triangles joined.

The fifth regular solid, the dodecahedron with 12 faces, each of which is a 5-sided pentagon, proved more complex and richer. The pentagon can be "stellated": that is, if you extend its five straight edges, the lines meet and form a



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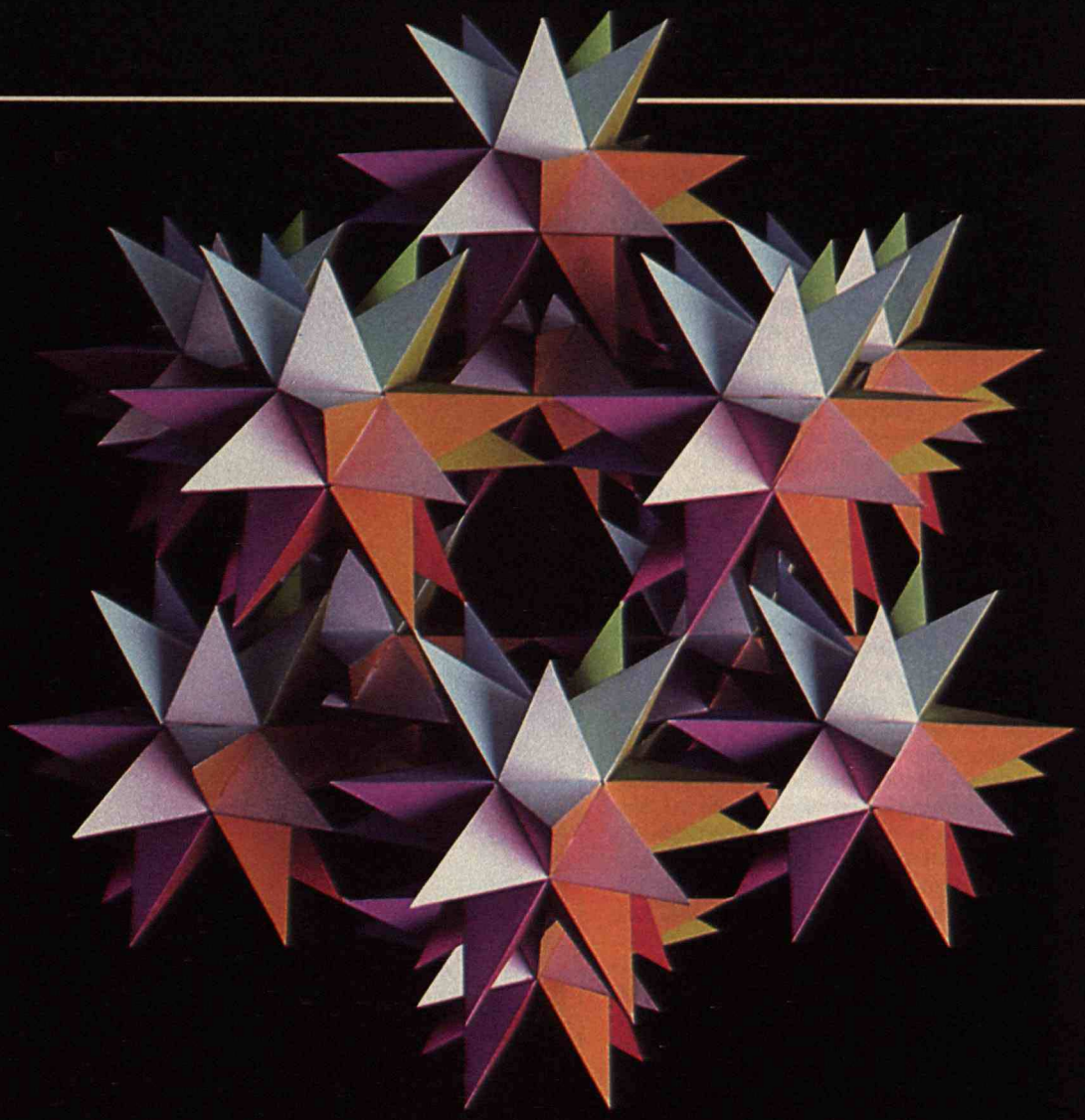


As the star cluster revolves slowly, all the seasons of the year seem on parade.

Just as you can extend the edge-lines of a pentagon to get a five-pointed star, so you can extend the face-planes of a 12-sided dodecahedron to get three-dimensional star-forms, or stellations. In fact, you get three stellations. At left, starting near the top dodecahedron and progressing downward, appear: the small stellated dodecahedron, the great dodecahedron, and the great stellated dodecahedron. Above: Bradley's "Constellation of 12 Great Stellated Dodecahedra." (Models: Alan Holden, *Shapes, Space, and Symmetry.***)**

five-pointed star. The Pythagoreans used the five-pointed star based on the pentagon—the "triple-interwoven triangle"—as a magic token by which to recognize other members of their sect. Plato believed that the dodecahedron was used by the Creator not for a particular element but for the shape of the whole universe.

It would be easy to ridicule Plato's naivete on such matters, but the rich cosmology of shapes—including Bradley's trees, Machiavellian knots, angel wings, and countless other possiblities—that emerge from the elemental Platonic solids is astonishing.

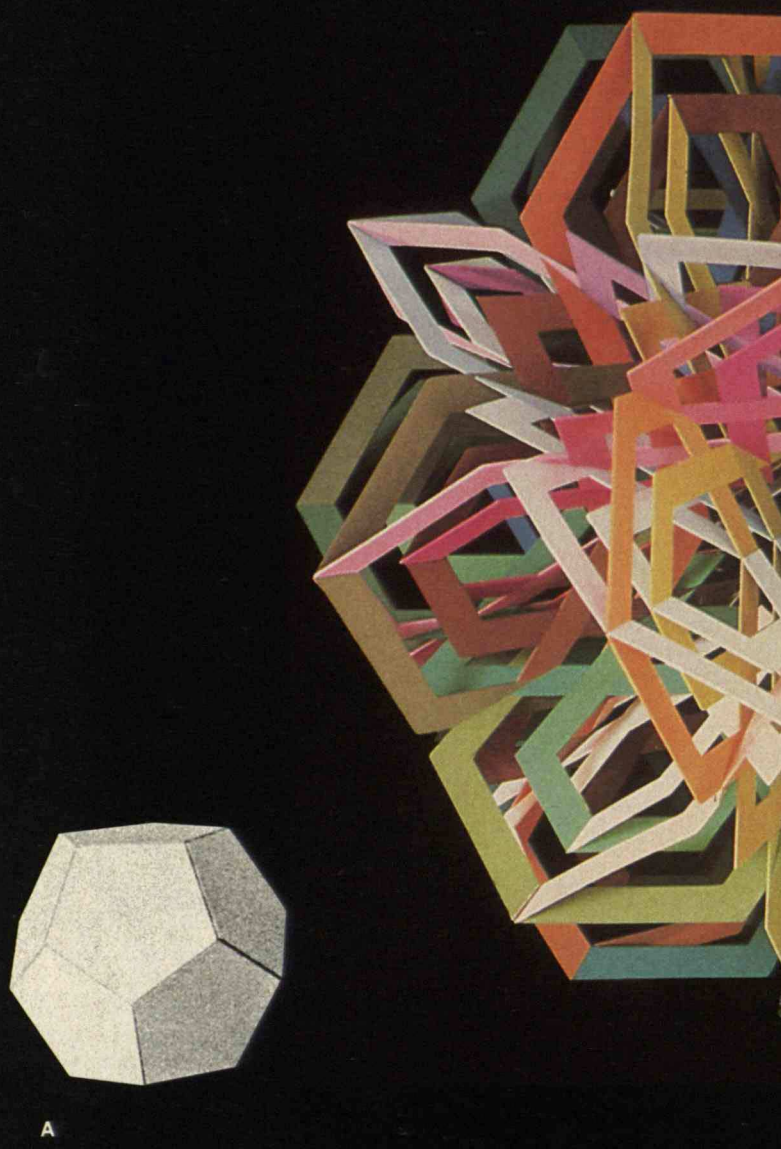
At the heart of this geometry is the so-called "golden ratio," approximately 1.618 to 1. Many consider this the most aesthetic proportion and prefer the golden rectangle, in which the ratio of the length to the width is about 1.618 to 1, above all others. Heath believes the Pythagoreans explored this ratio and says that the later Greeks certainly did. Some scholars have found the golden ratio in the proportions of everything from the facade of the Parthenon to playing cards. Leonardo da Vinci collaborated with a monk named Luca Pacioli to produce a book on this ratio entitled *De Divina Proportione*, and Leonardo used the golden ratio to define proportions in some of his artistic works.

To explore the mathematics of the golden ratio, take a line 1.618 feet long and divide it into two parts—one 1 foot long and one .618 foot long. The ratio of the whole line to the long part—1.618 to 1, the golden ratio—is about the same as the ratio of the long part to the short part—1 to .618. (Any hand calculator will verify that 1.618/1 is roughly 1/.618.)

This construction would work exactly if the true golden ratio were used instead of the approximation 1.618 to 1. To get this ratio, consider the series: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89 . . . where each number equals the sum of the previous two. The golden ratio is about 55/34, 89/55 comes closer, and the further you go, the more nearly the ratio of successive numbers approaches it.

If you take a pentagon and draw lines connecting its five points, the five-pointed star that is formed has golden ratios where the lines cross. You also get golden triangles—the ratio of either of the two long sides to the short side equals the golden ratio. When you combine Platonic solids into composite structures, as Bradley does, golden rectangles, triangles, and ratios appear everywhere.

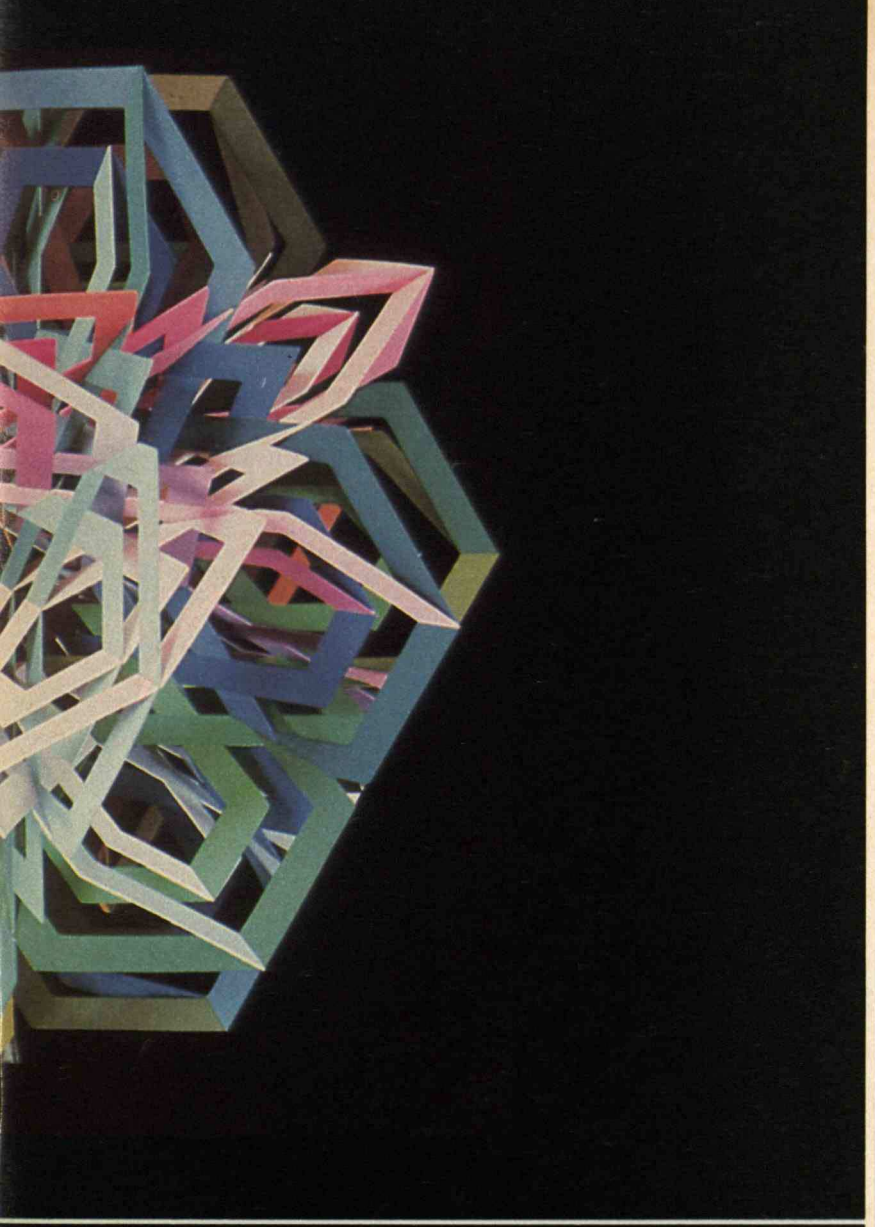
There are four more inhabitants of the

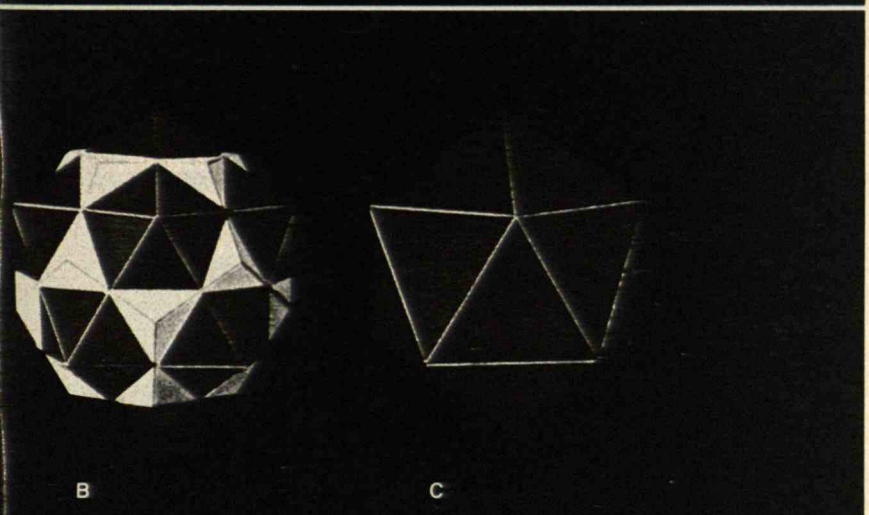


A

The sculptures' origins go back to five centuries before Christ, when the early Greeks' pessimism gave way to a mystical faith based on mathematics.

If you evenly shave off the 12 points of a 20-faced icosahedron (figure C, far right), you get a 12-faced dodecahedron (figure A, above left), and vice-versa. These two regular solids are called duals. When duals interpenetrate each other (figure B), their edges form right angles. If you cut off the black and





B

C

white points of this composite, you would form an icosidodecahedron with a combination of pentagonal and triangular faces.

Above: "Four Interlacing Bands on 10 Planes" is based on an icosidodecahedron. (Models: Alan Holden, *Shapes, Space, and Symmetry.***)**

world of perfect solids. Euclid proved in his *Elements* that the Platonic solids are the only convex regular solids. However, in the seventeenth century the Danish mathematician and astronomer Johannes Kepler went a step further. Kepler stood with one foot in the modern world and one in antiquity. He proved that the planets orbit the sun in ellipses; at the same time he was influenced by Plato's *Timaeus* and saw cosmic significance in the five regular solids. He discovered "stellations" of the Platonic solids that contain golden ratios.

Much as you extend the lines of a pentagon to form a five-sided star, you can extend the planes of a 12-faced dodecahedron and a 20-faced icosahedron to obtain three-dimensional starlike forms. In fact, the dodecahedron has three regular stellations: the small stellated dodecahedron, the great dodecahedron, and the great stellated dodecahedron. The icosahedron has many stellations but only one is regular, the great icosahedron. These four stellations together with the original five Platonic solids are the only regular polyhedra—solids with flat surfaces—that exist.

Sculptor's Workshop

One way Bradley discovers new combinations of golden ratios, triangles, pentagons, and stellations for his sculptures is by playing with a children's toy consisting of plastic sticks and rubber socket connectors. He holds up a dodecahedron with its 12 pentagonal faces outlined by the sticks of such a toy and discusses a sculpture that he is developing now: "I wondered what would happen if you intersected dodecahedra." That is, he wondered what would happen if stick-figure dodecahedra were somehow meshed together. "So I had Hal do that."

Hal—Harald Robinson—is one of the members of Bradley's loose-knit workshop. This group includes Louis Rosenblum, a mathematician who calculates the exact sizes and angles for sculpture parts; Joseph Parker, who with Robinson generally constructs the parts and preliminary "sketches"; and Linda Priest, who usually makes the finished pieces. Her skill is a minor legend. Someone once asked her if an artisan makes a truly round metal piece by using a template. "No," she said. "You feel it. It is easy to tell when something isn't round. What takes skill is applying the right hammer strokes to make the piece round." As the master designer, Bradley

communicates what he wants to the rest of the workers, rarely using paper and never measured drawings. Rather, he almost always talks face-to-face and, as he says with a smile, "I wave my arms."

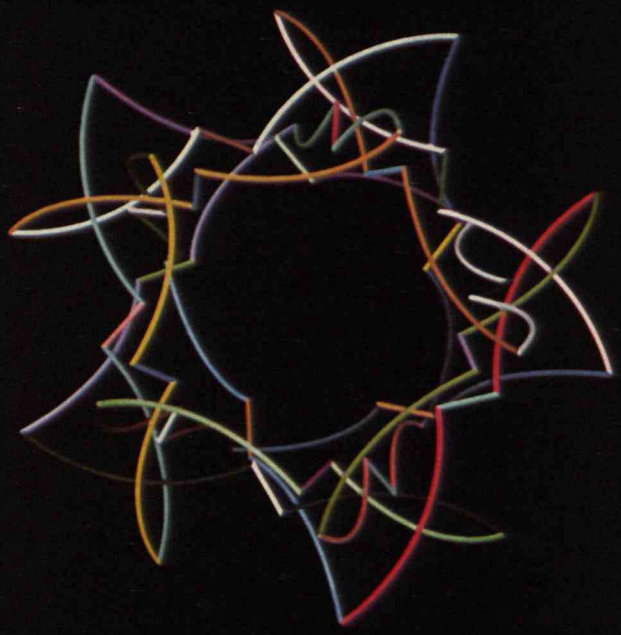
In the case of intersecting dodecahedra, Bradley waved his arms meaningfully and Harald Robinson understood and made a rough sketch. Bradley didn't know what would happen but was convinced *something* would. It did. Dodecahedra with their 12 pentagonal faces and icosahedra with their 20 triangular faces have a way of going together. It is no accident that $12 \times 5 = 20 \times 3 = 60$, one of those innumerable relationships that Bradley calls "neat." If you evenly shave off the 20 corners of a solid dodecahedron, you get an icosahedron. These two regular solids are called duals and are forever metamorphosing into one another. But as they do, they make patterns of fives and threes—pentagons and triangles. In Robinson's intersections of dodecahedra, Bradley was startled to see incipient squares.

"Most people handle a stick model like this for two or three minutes and don't even see the squares," Bradley says. "I noticed that three sides of a square started recurring, and I wondered what would happen if I added a fourth. So I dropped everything else and tried that." On a stick-form dodecahedron, he built stick-form squares pointing directly toward the center from each of the edges. Instead of making a mess, he produced a complex form that reveals a multiplicity of order.

But Bradley wasn't content. One midnight he wondered what would happen if he tried the same sort of thing with a stick-form icosahedron. (Bradley's ideas always come at midnight. He was once making a tree with branches splitting from branches, but it wouldn't work. At midnight he realized he should establish an alternating pattern using numbers related to the Platonic solids: 5 coming from 3, coming from 5, coming from 3, and so on. Of course, that worked.) Placing stick squares inside a stick icosahedron yielded a regular kaleidoscope of shapes. From inside to out they include:

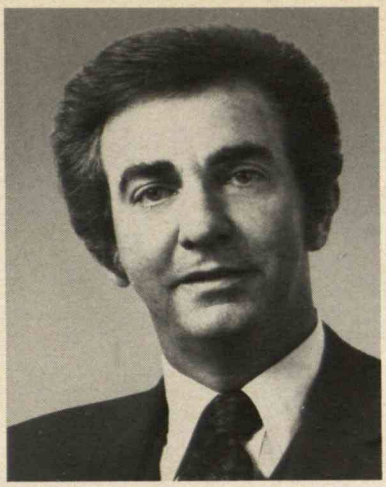
- ☐ one minuscule icosahedron
- ☐ one great stellated dodecahedron, a star whose points extend from each of the above icosahedron's faces
- ☐ one dodecahedron, outlined by the points of the above star
- ☐ one small stellated dodecahedron, a different star extending out from the faces

(Continued on page 87)



"When the geometries become so dense that you can't follow them," says Bradley, "I make a selection. That is where aesthetic judgment comes in."

Familiarly known as Matisse, this sculpture recalls the bright colors and simple forms of that artist's cutouts of dancing figures. However, the formal title is "Knot": a single line weaves through a geometric pattern and returns to the place it started from. The geometry is based on the dodecahedron, a regular solid with 12 faces and 20 points, or vertices. The knot connects the 20 vertices.



E. T. Bahre, Chairman-CEO, Computer & Communications Technology Corp.

"Puerto Rico has a positive can-do attitude. The government makes things happen."

"Puerto Rico's Economic Development Administration has initiated hundreds of successful start-ups," says Mr. Bahre. "They know the routine. So they're one step ahead all the way. That was an asset to us."

CCT's Information Magnetics subsidiary manufactures magnetic recording heads for computer disc drives. Its president, Fernando Velazquez, is one of the thousands of Puerto Rican born managers who hold top-level jobs with mainland subsidiaries here. CCT opened its doors in Puerto Rico in late 1980, and began shipping products within 60 days.

Mr. Velazquez adds: "Tax incentives are certainly a major benefit in Puerto Rico. But the key to it all is the people.

"We insist on testing every head we manufacture. Our Puerto Rican work force has a commitment to our high quality standards. They've already made beneficial improvements to our quality program."

Both executives agree that CCT is in a strong growth mode and will expand in Puerto Rico. Because this manufacturing center has the means "to produce and ship profitably."

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Fernando Velazquez, President of CCT's subsidiary in Moca, Puerto Rico

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For more information: write us on your company letterhead. Puerto Rico Economic Development Administration Dept. TR-3, 1290 Avenue of the Americas, New York, N.Y. 10104. Or call us toll-free: (800) 223-0699. Ask for Carlos Marquez, Deputy Administrator. In New York State, call (212) 245-1200.

With a personal computer,
anyone can enter vast treasure houses of information.
But the venture isn't always cheap
and the path is still
a bit rocky.

Personal Computers: Passport to the Electronic Universe

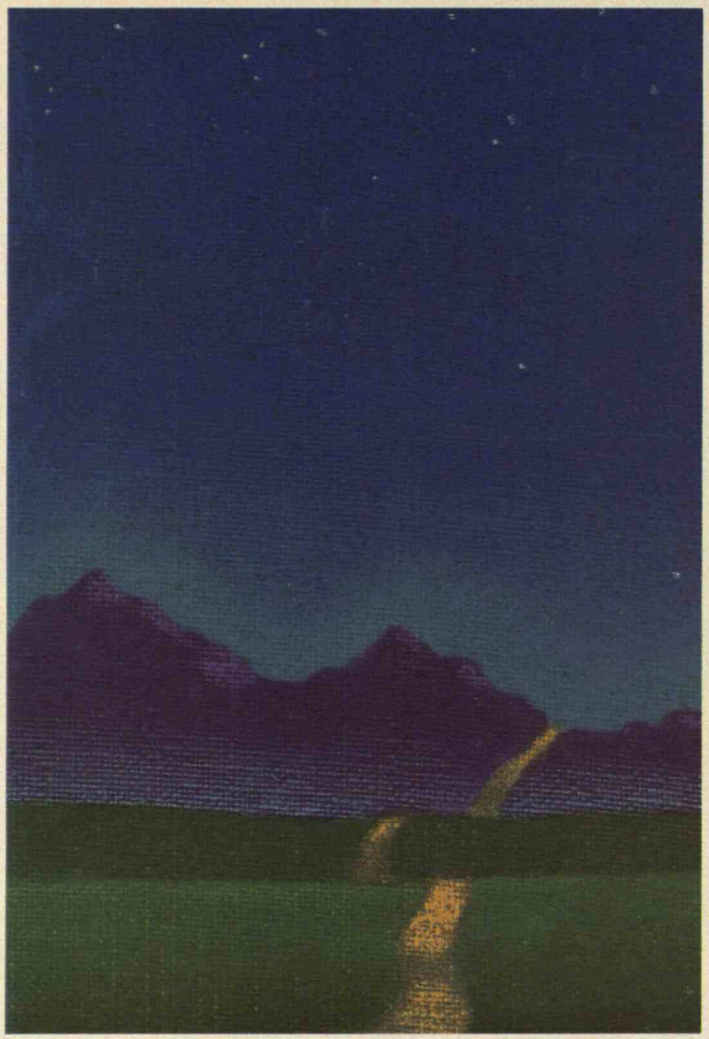
ALTHOUGH millions of personal computers have been sold in the past few years, for many owners the machines are very much like Dorothy's ruby slippers in *The Wonderful Wizard of Oz*. Individuals and businesspeople use their computers daily to handle accounting chores, solve scientific and financial problems, work through "what-if" analyses, play games, and process words. Yet just as Dorothy never suspected that her slippers had the power to whisk her away at any time, few personal-computer users suspect that their machines also have the power to transport them to a completely different universe.

But they do. And in years to come this power may be seen as the best reason to buy a personal computer. You can already use your machine to tap into giant mainframe computers, commanding them to search through literally millions of records for just the fact, figure, or statistic you want. You can send electronic mail that will be delivered instantly to your correspondent's electronic mailbox. You can find a job, publish a poem, meet a friend, consult an encyclopedia, and do hundreds of other things directly from your office or home. The problem for computer

BY ALFRED GLOSSBRENNER

ILLUSTRATIONS: KATHERINE MAHONEY

owners is choosing the most useful and economical services. That task, not simple today, will be even more complicated when the crescendo from competing services develops later this decade.



The Basics of Going On-Line

The electronic universe exists because virtually all computers and "dedicated" word processors can be equipped to communicate over telephone lines. Thus, you can use anything from an $80 Timex/Sinclair computer purchased at the local drugstore to a fully equipped IBM/PC or Apple Lisa costing $10,000 or more. If you already own a computer or word processor, the only other equipment you will need is a special circuit board called a communications card, a telephone interface box called a modem, and a communications software package. The total additional cost can be as low as $300. Indeed, in some cases, as with the Commodore VIC-20, you can get all of these plus the computer itself for about the same amount of money.

The communications card is a microchip-filled circuit board designed to be plugged into one of the "expansion slots"—or empty sockets—inside your computer. The card is responsible for converting the computer's internal communications into a form that can be used to send information over telephone lines. The various components of most microcomputers communicate with one another by sending and receiving "bits" (*bi*nary digi*ts*) of information. Each bit is actually a specific voltage level, and in most computers they travel in eight-unit chunks called bytes. All eight bits in a byte move together through a computer and all arrive at their internal destination at the same time.

If you visualize a rainbow and pretend that each swath of color represents one of these eight bits, you'll have a good idea of why this mode is called "parallel" communication and why at least eight wires are required to bring it off. But telephone cables don't have nearly enough wires, which means that the computer's parallel communications must be converted so that bits leave the machine and head for the phone one at a time, or in a "series." The communications or "serial-interface" card makes this conversion and then sends the bits along to the modem, which in turn is connected to your phone line.

Telephone lines can carry only sound, and it is the modem's job to convert the electrical impulses—the bits—leaving your computer into analogous sound tones. The modem, short for "modulator/ demodulator," also converts the incoming tones from the remote computer into electrical impulses acceptable to your computer. You'll find many modems to choose from, but by and large you will be wise to select a "direct-connect" modem that can be plugged into a modular telephone jack.

Finally, you will also need a communications program. As with everything else in the personal-computer field, there is a wide variety of communications software to choose from. You could write (or copy) a barebones program yourself containing fewer than 70 lines of code—or programming instructions. But more than likely, you'll appreciate the additional features found in commercial packages.

One other point to be aware of in going "on-line" is that in many cases you can dial a *local* phone number to gain access to a distant computer. A number of companies have established communica-

You can find a job, publish a poem, meet a friend, consult an encyclopedia, and do hundreds of other things directly from your home or office.

tions networks throughout the continent. The networks that personal-computer owners use most frequently to gain access to commercial databases and services are GTE's Telenet, Tymshare's Tymnet, and Uninet, although many other networks exist. These consist of geographically dispersed "nodes," "engines" (the computers located at the nodes), high-speed "memory shufflers," and lots of telephone lines and switches. And they make use of a concept called "packet switching" developed by the Bell System, the U.S. Defense Department's Advanced Research Projects Agency (ARPANET), and other organizations in the early 1970s.

As information from your computer comes in over the phone to a regional node, it is divided into "packets" of signals. Each packet is "stamped" with the address of the remote computer you want to talk to and the necessary routing information. The packet is then sent on its way through a switching system via the most efficient route. When it arrives at its destination, the information it contains is fed to the mainframe or other computer you wish to gain access to. The same process takes place when the remote computer sends information to you.

Because none of this manipulation is apparent to the personal-computer user, the networks are often called "transparent" systems. But while they may be invisible, the electronic universe clearly could not exist without them. Dialing a separate number for each computer you want to tap would not only be inconvenient but would also be prohibitively expensive at normal long-distance rates. Using packet-switching networks, you can talk to any commercially available computer in the country for about ten cents a minute, regardless of your location. Billing is handled by the owner of the remote computer system.

Surveying the Electronic Universe

Now that you are ready to dial the phone and go online, who should you call? If you want to get your feet wet immediately, you might try one of the many "computerized bulletin board systems" (CBBS) throughout the continent. These normally consist of a private individual's personal computer equipped to answer the telephone automatically. They are typically operated as hobbies and are free except for telephone charges—though in this case you may pay for a long-distance call, since CBBSs don't use the packet-switching networks that commercial systems do.

Using CBBSs is an easy, low-cost way to introduce yourself to personal-computer communications. And they are always a surprise, for you never know what you will find when you call one up. Some, for example, offer tips and techniques for using an Apple, IBM, Radio Shack, or other computer. Others offer information on topics such as photography, genealogy, self-help, education, and science fiction. Some are definitely X-rated. And many offer free software programs for you to "download" (capture as they come into your machine). These programs can be recorded on a "floppy disk" memory device and run just as if you had purchased them or written them yourself.

(For a list of many of the CBBSs available in North America, you can dial: (213) 881-6880. You will reach a system operated by Novation of Tarzana, Calif., manufacturers of Cat Modems, that's available 24 hours a day, free of charge. For those ready to go, here are the specifics. Set your system to full-duplex, 300 baud, a word [or character] length of seven bits, even parity, and one stop bit. Turn on or "enable" your echo, and set your modem to "originate." Then dial the phone. When the word CONNECT appears on your screen, hit your <ENTER> key twice to tell the system you're there. When the message LOGON PLEASE appears on your screen, type CAT. You will next see a long list of "menu selections." By choosing the selection called "DIRECTORIES," you can obtain a list of over 200 CBBSs, classified by area code.)

Computerized bulletin board systems are a phenomenon waiting to catch fire. There are currently fewer than 500 such systems in the country, but as computer prices fall, this number is bound to grow. However, since the systems are operated as hobbies, they tend to be irregular in both availability and the quality of information they contain. To obtain really useful information, you must subscribe to one or more of the commercial database services.

What You Need Is What You Get

According to the *Directory of Online Databases*, published quarterly by Cuadra Associates of Santa Monica, Calif., there were over 1,350 commercial databases by the fall of 1982—a 40 percent increase over the previous year. Over 95 percent of these databases are accessible to anyone with a communicating personal computer or word processor. All

charge a fee for the services and information they provide.

Most commercial databases are highly specialized, offering you the opportunity to use the database computer to search through millions of pieces of information on a single subject. For example, a database called HORSE offered by Bloodstock Research of Lexington, Ky., can provide you with the pedigree and racing record of every thoroughbred horse active in North America since 1900.

A database called IMSPACT can tell you just about everything you'd care to know about the health-care market, including drugstore and hospital purchases of pharmaceuticals and other products by month for the past six years, numbers of prescriptions written or refilled for any drug, medical journal advertising by size and cost of ad, and so forth. Using PATCLASS, you can search through more than 4.2 million patents awarded since 1836, retrieving any one on the basis of patent number, class, or subclass. SMARTRANS ("smart electronic translator"), offered by Smart Communications of New York, offers instant translations of technical and scientific terms from one language to another. Language choices include French, Spanish, German, Portuguese, Arabic, Japanese, and English.

Single-subject databases such as these are fine if you often need the particular facts and figures they can supply. But for most people, these databases are too narrowly focused to justify a subscription. If you do need these services occasionally, you would be better off hiring an information broker or search specialist to obtain the material for you. *Information Industry Marketplace*, published by R. R. Bowker Co. ($40) and updated annually, contains an extensive list of firms in this field.

The majority of personal-computer users will find subscriptions to the major "encyclopedic" databases and "information utilities" much more useful. An encyclopedic database offers access to many single-subject databases. For example, when you subscribe to DIALOG, a subsidiary of Lockheed Missile and Space Co., you are issued an account number and password giving you access to over 150 individual databases. These range from ABI/INFORM, which covers more than 550 business-related journals and magazines published since 1971, to ZOOLOGICAL RECORD, which covers all information pertaining to protozoa, pisces, reptillia, and the like published in 6,000 journals worldwide.

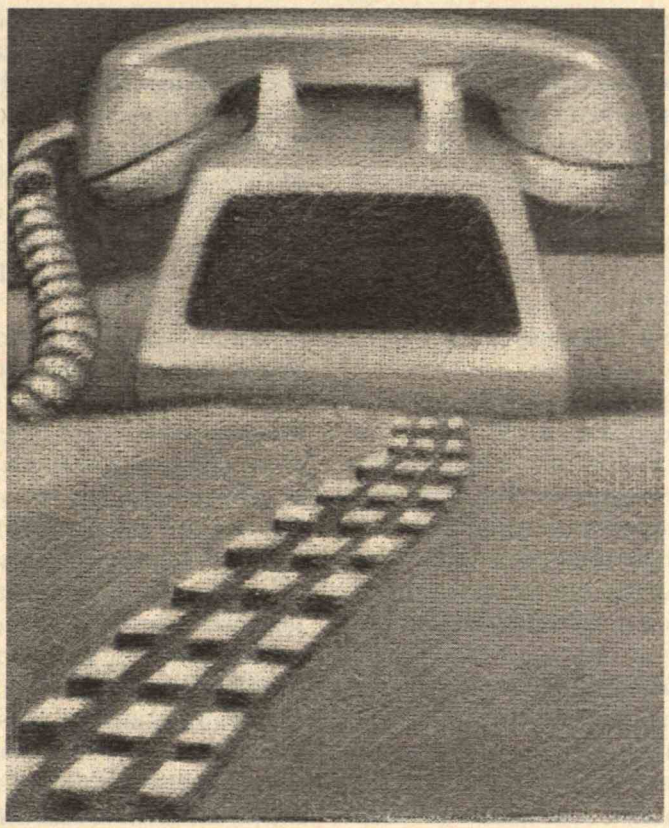
Like a department store, DIALOG offers all these products under the same roof, as it were, handling all the billing and other services related to the individual databases you use. The other major encyclopedic databases are BRS (Bibliographic Retrieval Service), based in Latham, N.Y., and owned by Indian Head, Inc., and ORBIT, a product of SDC Search Service, a firm recently acquired by the Burroughs Corp. Each offers 70 to 80 databases, some of which are also available on DIALOG and some of which are exclusive to BRS or ORBIT.

In addition to their breadth and depth of coverage, the power of the encyclopedic databases lies in the fact that all the information they contain is "keyword searchable." That is, you can sign on to DIALOG, specify the EXCERPTA MEDICA database, and order a computer search for every reference to the neurological disorder known as Alzheimer's disease published in over 3,500 biomedical journals. If you like, you can limit the search to specific journals and date ranges. Or you can look for references to Alzheimer's disease and particular genetic traits, or Alzheimer's disease and dietary trace metals, or any other combination of key words to help you pinpoint specific information.

Realistically, you probably will not be able to conduct such a precise search the first few times you sign on to DIALOG. All encyclopedics have a "search language" consisting of the symbols, abbreviations, and words one must use to tell the computer how to conduct its search. These languages, which are explained or "documented" in the literature you receive with your subscription, can take a while to master. The encyclopedics also offer training sessions in various cities around the country and provide low-cost "practice" databases for you to use in refining your skills. Once you master a search language, you can apply it to all the databases available on a particular system—one of the advantages of having so many under the same roof. And with the manuals as your guide, you can learn enough on your own to conduct a reasonably efficient search almost from the start.

However, it's important to point out that the encyclopedics do not normally supply the full text of a magazine, newspaper, book, or journal article. The complete *Harvard Business Review* is available on BRS, but this is an exception. Storing the full text of so many publications would simply occupy too much computer memory to be affordable. Instead, the encyclopedics provide bibliographic citations and

The electronic universe exists because virtually all computers and "dedicated" word processors can be equipped to communicate by telephone.



abstracts of the material. Often this is enough, since bibliographic citations contain the title, author, publisher, date of publication, and all other information needed to quickly locate a particular work in a library. Abstracts include this information as well as a summary of all salient points and statistics. In many cases, if you decide that you would like to see the complete book or article, you can place your order on line and the item will be photocopied or located and mailed to your address.

Versatility via Utilities

Information utilities are designed to serve an even broader audience and perform more functions than the encyclopedics. The term "information utility" was coined by The Source, one of three major databases that currently meet this description. The other two are CompuServe and the Dow Jones News/Retrieval Service. The Source is sometimes referred to as STC for Source Telecomputing Corporation. CompuServe is frequently called CIS for CompuServe Information Service. And the Dow Jones News/Retrieval Service is usually abbreviated as DJNS.

The utilities offer both information and services. On the information side, this includes the latest news, weather, and sports; most major wire-service features and columns (Jack Anderson's "Washington Merry-Go-Round," "Supermarket Shopper," "Your Stars This Week"); *The World Book Encyclopedia* (CompuServe) and *The Academic American Encyclopedia* (Dow Jones); *The Washington Post* and three other newspapers (CompuServe); *Barron's* and the *Wall Street Journal* (Dow Jones); commodity and stock-market prices and business information; airline schedules; restaurant guides and movie reviews; and much more.

While the utilities provide access to a great deal of information, you will not find the same depth of coverage that is available on the encyclopedics. The one exception is Dow Jones News/Retrieval, which can tell you everything you could possibly want to know about any publicly traded stock, bond, or financial issue. But for most people, the information these utilities provide is more than enough. Indeed, unless you need regular access to the kind of information only an encyclopedic can provide, you should probably start your life on-line with a subscription to one or more of these utilities.

And then there are the services, ranging from electronic banking and game playing to the opportunity to write and run programs on mainframe computers. For example, on-line shopping and electronic mail are just two of the noninformation services offered by the utilities. All three utilities give you access to a discount shopping service called Comp-U-Store, a division of Comp-U-Card of America in Stamford, Conn. With Comp-U-Store you can obtain a price quote on any one of more than 50,000 brand-name products. If you do not have a particular item in mind, the system will walk you through a selection process. ("Do you want a color TV or a black & white?" "Remote control or standard?" "Do you want to specify a particular brand?") Prices are typically 20 to 40 percent lower than what you would pay at a local store. And if the price is satisfactory, you can enter your order on-line. The item will be charged to your credit card and shipped in its factory-sealed carton with a full warranty in about two weeks.

The electronic mail services offered by the information utilities are an even stronger drawing card. (Dow Jones has not yet implemented an electronic mail service but is said to be planning to do so in the near future.) Every subscriber to The Source or Com-

puServe has an account number that also serves as an electronic mailbox.

In its simplest form, electronic mail allows you to send a letter to anyone else who subscribes to the same utility. You tell the system that you want to send mail, type your letter at your keyboard, enter the recipient's account number, and type the command to send the letter. Within seconds the letter "arrives" in the other person's "mailbox." That individual can read the letter the next time he or she signs on to the system, be it in the next five minutes, the next ten days, or longer.

This is only the beginning, however. You can also create a mailing list consisting of up to 200 subscribers and send the same letter to all of them by hitting a few keys. You can prepare a letter, report, or memo with a word-processing program on your personal computer before dialing the phone and then "upload" (transmit) the text to the information utility. The text is then sent just as if you had typed it while on-line.

Electronic mail is especially attractive in business. Some *Time* magazine correspondents routinely use this technique to transmit their articles and notes to the home office in New York. And several law firms use electronic mail to negotiate contracts for their clients. For example, an attorney in New York might draft a contract on a word processor or personal computer and transmit it to the electronic mailbox of an attorney in Los Angeles. The L.A. lawyer would sign on to the information utility, download (capture) the draft, and make changes. The revised draft would then be uploaded to the New York attorney's electronic mailbox, and the process would continue until a final agreement was reached. This technique has reduced the time required to negotiate some contracts from several weeks to two days.

If electronic mail is of major interest, you should probably subscribe to The Source, which offers the most sophisticated mail system and is available 24 hours a day. In contrast, CompuServe is available only between 6 P.M. and 5 A.M. (your local time), and a single letter can be no longer than about 80 lines, though you can divide your message and transmit it as several letters.

The information utilities, in short, offer a vast smorgasbord of information and services—a feast that is growing richer each day. With its hardware, software, and delivery mechanisms now well established, each service can easily add services and databases. All three are doing exactly that.

The three utilities are also rapidly adding subscribers. CompuServe and The Source, with over 30,000 subscribers each, report growth rates of 1,000 to 2,000 new accounts a month. With a subscriber base of over 60,000, Dow Jones reports a growth rate of over 3,000 accounts a month. In fact, William Dunn, president of Dow Jones Information Services, recently predicted that by 1984 Dow Jones would have 250,000 users.

You may also find two other major databases particularly useful. One is the New York Times Information Service, or NYTIS (pronounced "nite-us"). The other is NewsNet. Like an encyclopedic database, NYTIS offers access to a number of discrete collections of information. But the one most people find interesting is The New York Times Information Bank. This database can provide you with the full text of every edition of the *Times* from 1980 to the present. About the only thing it does not include are ads, shipping announcements, and crossword puzzles. It can also supply abstracts from nine other newspapers; business publications such as *Advertising Age* and *Women's Wear Daily*; science publications such as *Aviation Week and Space Technology*, *Science*, and *Scientific American*; and other periodicals including *The Atlantic*, *Consumer Reports*, *National Review*, *Variety*, and the major newsweeklies.

Unfortunately, by September 1983 NYTIS will no longer be available to most computer owners, since the company is phasing out its marketing and computer operations. The information services will be available via the Nexis system operated by Mead Data Central, but Nexis is now accessible only through a special terminal that must be rented from the company. There is no technical reason why, given the proper software, a standard personal computer cannot provide access to the Nexis database, and one can assume that Mead is considering the possibility. But the firm has given no indication of its plans.

NewsNet, based in Bryn Mawr, Pa., offers its subscribers access to nearly 150 trade and industry newsletters, including "Advanced Office Concepts," "Bank Network News," "Cellular Radio News," "IRS Practices & Procedures," "The Gold Sheet," "The Seybold Report," and "Video Games Today." While most of these are identical to the printed publications you would receive in the mail, 15 percent are available only on NewsNet. By the end of this year,

The majority of personal-computer users will find subscriptions to the major "encyclopedic" databases and "information utilities" most useful.

NewsNet will have between 300 and 400 newsletters on its system. Ultimately, it plans to offer some 2,000 of the 10,000 newsletters published in the United States.

Obtaining your newsletter news via NewsNet has a number of advantages, not the least of which is speed of delivery. More than 40 percent of the publications are transmitted to NewsNet computers electronically—fresh from the word processors or personal computers of their authors. They are thus available several days before the print version wends its way through the mail to your doorstep. More important, you usually do not have to be a subscriber to the print version to read a newsletter. However, print subscribers do get reduced rates when receiving their newsletters on-line.

There is also the power of "keyword searchability." NewsNet subscribers can command the system to retrieve any article containing a particular keyword. This search can include all current and back issues of a single newsletter, all newsletters dealing with a particular industry, or every newsletter on the system. You can also ask the system to notify you automatically whenever a newsletter containing one or more keywords is added to the database.

From the simplest computerized bulletin boards to the far-reaching information utilities, these systems can be thought of as the landmarks of the electronic universe as it exists today. And the business of providing on-line services and information is just getting started and will certainly expand. However, for all its wonders, the on-line universe is far from being an electronic Eden.

Snakes in the Garden

On the second Tuesday of every month, an informal group of people interested in the information industry lunch together at New York's charming Hotel Algonquin. At one recent gathering, the director of information services development for a major publishing company spoke of a database demonstration she had prepared for the firm's president and patriarch. During the demonstration, the president was "knocked off-line" (disconnected) twice for no apparent reason. After entering choices from the various menus numerous times—and consistently waiting five minutes or more for the remote computer to respond—this forward-thinking septuagenarian looked up and said, "It's not ready for the general public yet, is it?"

One might quibble with definitions of the "general public," and note that companies are making great efforts to eliminate these problems, but the gentleman has a point. Things aren't perfect yet. Drawbacks include a general lack of information and instructions, mechanical and technical problems, and fundamental design inadequacies. Hovering above all these problems is the basic question of the cost of acquiring and using these electronic marvels.

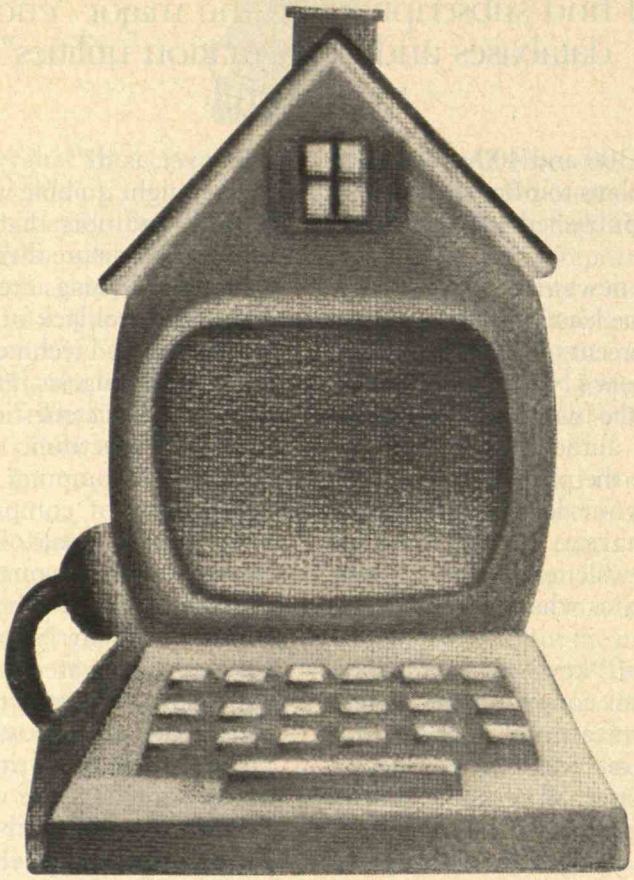
The microcomputer industry in general is plagued with a lack of comprehensive, easy-to-understand instruction manuals. Paying $5,000 or more for a top-of-the-line personal computer or $500 for a full-featured software program is no guarantee that the product will arrive with adequate instructions. Although there are numerous exceptions, this problem is so widespread that poorly written, confusing instructions are almost to be expected.

The problem of insufficient information also afflicts databases, the veritable gatekeepers of the Information Age. And this drawback can make using a system more difficult than it should be for the average person. Although the documentation supplied by The Source and DIALOG is superb, the "manuals" provided by many other services range from merely adequate to virtually useless. Instructions may be incomplete, poorly explained, or totally inaccurate. And in such a rapidly changing field, keeping the manual up-to-date is a constant problem.

DIALOG is the only service with a well-developed update program: new inserts for the manual arrive each month with the regularity of electric bills. The Source has an updating program but is currently many months behind schedule. The other services typically announce new features in newsletters that may or may not contain instructions for the user.

Most systems do include a "help" function that will give you on-screen descriptions of various commands and features. But this information is designed only for quick reference and is not intended to provide a detailed explanation. Thus, discovering a system's features and how to use them can be alternately fun and frustrating. It's almost always worth the effort, but it does require connect time, and that costs money. This situation will undoubtedly improve as the industry matures.

Like all time-sharing systems, database computers use a technique called "polling" to make certain that everyone connected to the system is served in turn.



This means that the system acts upon one command from your personal computer and then "moves on" to perform the same service for someone else. The polling cycle should be fast enough so that by the time you're ready to enter another command, the system is again ready to accept it. Ideally, you will perceive no delay between the time you hit your <ENTER> key and the time the system responds.

However, host systems have a limited capacity, and when the number of people on-line approaches that limit, each polling cycle can take considerably more time. Thus, you may sometimes enter a command and then have to wait for the system to act. This can be (and is being) corrected by adding capacity to the host systems. But that thought is of little comfort if you're sitting at your machine waiting for something to happen, knowing that each minute adds a dime or more to your bill.

A number of information services also suffer from fundamental design problems. Some lack internal consistency, requiring the user to enter a command such as "STOP" for one feature and "QUIT" to accomplish the same thing for another feature. Others lack the thoughtful, common-sense design or "human engineering" needed to make them truly "user friendly." Indeed, in some cases, it is obvious that no one gave serious thought to how a human being would actually use a particular feature or service.

There are reasons for such failings. The Source, for example, was created in 1979 by a group of entrepreneurs who found that starting a new business and helping to found a new industry left little time or money for the niceties of human engineering. Now that the Readers Digest Association has acquired a controlling interest in the company, these problems are gradually being solved. But many of the original features have yet to be revised.

CompuServe Information Service was started as an adjunct to the parent firm's remote-data-processing business. If the firm could attract "hackers" interested in doing programming during off hours, so much the better. If not, there was not much to lose, since the company had invested little in features and services and the host computers had to be up and running in any case. Only recently has CIS begun to make a concerted effort to address the huge nonhobbyist market. Thus, the design of many of its features still reflects its low-budget past.

Poor design and lack of consistency obviously make a system more difficult—and more expensive—to use. Confusing or poorly written on-screen instructions can force you to guess at the right command. If you guess wrong, you may find that you have inadvertently sent the host system off in the wrong direction. Stopping it and getting it back on track will require additional commands and connect time.

Money: The Green-Eyed Goblin

Henry Kisor, book editor for the Chicago *Sun-Times*, is an enthusiastic new apostle of on-line communications. Perhaps a mite too enthusiastic, for as he writes in a personal letter, "I didn't have much of a chance to learn the ins and outs of The Source before I was slugged with an enormous bill." Kisor doesn't say what constitutes "enormous," but he has recently put himself on a strict time ration to hold his bills in check.

There is no getting around it. Whether owing to inadequate printed instructions, technical problems, unfriendly design, or sheer curiosity and the urge to explore, using a database can be an expensive proposition. As any computer widow or widower can attest, users can lose all track of time when working with their systems. There are two primary concerns

The information utilities offer a vast smorgasbord of information and services, a feast growing richer every day.

to bear in mind when considering the cost of on-line communications. The first is the money you'll spend getting to know a particular system, and the second is the value of the information and services you receive compared with their cost.

As a new subscriber to an information utility or other database, you should simply acknowledge the fact that, as with Defender, Donkey Kong, or other quarter-a-shot video games, a definite learning curve is involved. The amount of money you'll have to spend to ascend the curve will depend upon the documentation supplied, the complexity and design of the system, your previous experience, and so forth. But you will have to spend some money to achieve a given level of mastery. Naturally it makes sense to do your learning during the inexpensive evening and late-night hours.

The question of cost versus value depends entirely on the individual. While information is important for investors and business, academic, and research-oriented users, most private users tend to be far more interested in the services offered—electronic mail, computerized conferencing, public bulletin boards, and real-time communication features such as CHAT on The Source or CB on CompuServe. If you don't *need* the information or services that databases offer, it will be extremely difficult to justify their cost. On the other hand, you may *want* them, perhaps for purely recreational purposes. Only you can decide.

Before making up your mind, however, there are several points to consider. You should not make a final decision about a particular system until you have taken the time to get to know it. Trying a system is not expensive, and with the exception of The Source and NewsNet, you will not be committed to an ongoing expense. As with a magazine or cable-television subscription, you can cancel at any time. And although some people do indeed run up connect charges of $100 a month or more, that is the exception. The Source, for example, reports that the average subscriber spends a total of about $25 a month on the system.

Subscribers should also bear in mind that delivering on-line information and services is not an inexpensive undertaking. According to Graeme Keeping, the former chief executive officer of The Source, at $4.25—the lowest hourly connect rate prior to August of 1982—the firm was actually losing 25 cents an hour whenever a subscriber used the system. The rate has since been raised to $5.75 an hour, setting off a chorus of on-line protest by regular users.

On the plus side, databases are largely a fixed-cost business. Once a system has been set up, the cost of adding new subscribers is relatively low, and as subscriber bases grow, prices may drop. Something of the sort is already happening with DIALOG and BRS, both of which have recently introduced low-cost services aimed at the individual user as opposed to the libraries, universities, and corporations that make up their traditional subscriber base.

Thus, in the future the information utilities and other databases will undoubtedly be both affordable and available to millions of people. And there will be millions. International Resource Development, a high-tech research organization based in Connecticut, recently forecast that by 1993, fully half of the 100 million U.S. households will contain a personal computer. Of these 50 million machines, 14 million will be equipped for on-line communications.

The extraordinary but unsuspected power of ordinary objects is a recurring theme in fantasy and fairy tales. Jack and his handful of ordinary-looking beans, Frodo Baggins and his plain gold ring, and Dorothy and her ruby slippers are but a few examples. The paradigm of this theme in the personal-computer age may well lie in the Colossal Cave of the popular computer game "Adventure," created at M.I.T. In one chamber of that cave, the adventurer comes upon an ordinary iron rod with a bent, rusty star at its tip. No instructions accompany the rod and there is no requirement that you pick it up—you can pass it by and continue your explorations without it. But should you choose to take it with you on your journey, and should you learn how to use it, you will cross crystal bridges to discover treasures you might never have found any other way.

Although it will be some time before personal computers will be considered "ordinary," much the same thing could be said of them today. There's no requirement that you join the electronic universe—you can pass it by and continue your journey. But if you don't join, you will never know the true power of your personal computer.

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Meeting Japan's Challenge
Fifteenth in a Series

MOTOROLA HAS ALL THE HARDWARE, SOFTWARE AND TALKWARE TO REVOLUTIONIZE THE MOBILE TELEPHONE CALL. INTERESTED?

So is Nippon Tel. & Tel.

The new cellular technology will provide dramatic improvements in mobile telephone service.

Equipment for the new systems is being installed by many telephone companies around the world. One of the most comprehensive installations serves the customers of Nippon Telegraph and Telephone Public Corporation in Japan.

And in their latest reviewing procedure for new mobile telephone equipment, only one non-Japanese supplier was selected to qualify for field test. That supplier is Motorola.

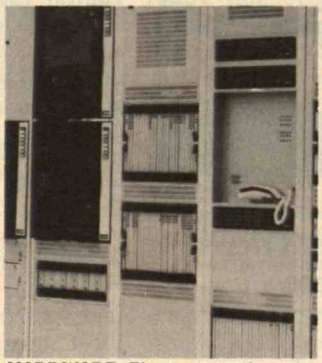
Motorola is the only source ready to deliver a completely integrated cellular mobile/portable phone system, anywhere. It includes all the hardware, software and talkware necessary for a total network.

What does that mean to American business? It could mean a lot.

When Motorola cellular technology comes to your area, you'll have virtually the same quality of communication between your mobile people and your offices anywhere in the world as you now have between fixed phone installations.

Moreover, the old waiting period for a free channel will be a thing of the past. The frustration of incompleted calls will be vastly reduced. And the service capacity of the new cellular systems will be significantly greater.

The complete Motorola DYNA T·A·C cellular mobile/portable phone system has been in operational test since 1981 in the Baltimore/Washington market. Its performance has lived up to all expectations.



HARDWARE: Electronic exchanges, multi-channel base stations, base site controllers.

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5134          **********
5135          * PROCESS HANDOFF PRIORITY
5136          **********
5137
5138        CALL SOMHHNDPRI (,,S_EXC_MSG
HND_PRI       EQU     $
              LD      DE,(S_EXC_MSGDAT)
              LD      HL,(S_EXC_ORGPRT)
              CALL    SOMHHNDPRI
5139        GO TO T_RETURN
              JP      T_RETURN
5140
5141    T_HND_REQ:
5142
5143          **********
5144          * PROCESS HANDOFF REQUEST (
5145          **********
5146
5147        CALL SOMHHNDREQ (,,S_EXC_MSG
HND_REQ       EQU     $
              LD      DE,(S_EXC_MSGDAT)
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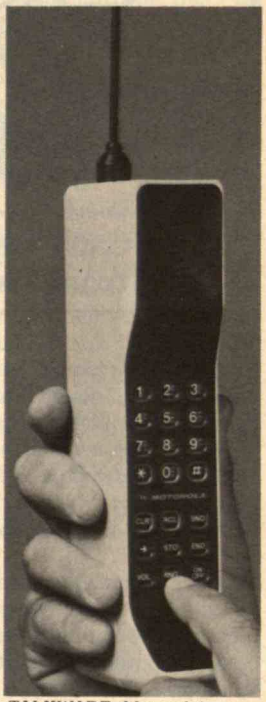
SOFTWARE: Full system control for sophisticated billing and tariff requirements, cell-to-cell handoff of calls, call routing and automatic roaming.



TALKWARE: Motorola's DYNA T·A·C portable weighs a mere 28 ounces and puts all the features of the most advanced car telephone in the palm of your hand.

The cellular revolution is rapidly becoming a fact, worldwide. And by building all types of major signaling systems in all major frequency bands, Motorola will play a major role in supplying these new systems.

We've put many years of careful, creative engineering into this technology, and over $100 million in direct investment. For us, the cellular revolution is an eagle we've nursed and nurtured from a fledgling.

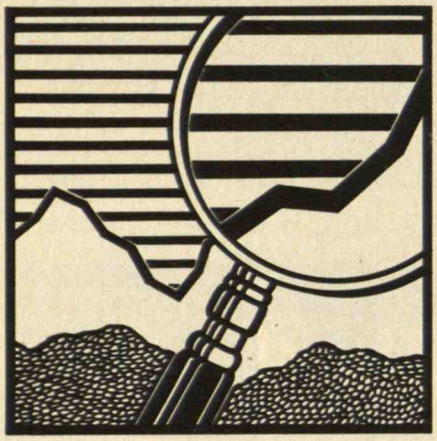
Today we offer our cellular hardware, software and talkware complete with service, installation and a dedication to customer satisfaction that never expires.

And when you offer all that to any customer, nothing gets lost in the translation.

MOTOROLA A World Leader in Electronics.

Quality and productivity through employee participation in management.

Better Business, Networking, and Science Museums



You Can't Get There from Here

In Search of Excellence: Lessons from America's Best-Run Companies
by Thomas J. Peters and Robert H. Waterman, Jr.
Harper & Row Press, 1982, $19.95

Reviewed by David A. Garvin

American managers today are a beleagured lot. A stagnant economy, demanding regulations, and intense international competition complicate their already difficult jobs. Now a new concern has recently joined that list—the public's growing belief that management weaknesses are at least partially responsible for the poor performance of U.S. industry.

American managers, according to this view, simply aren't as effective as their European and Japanese counterparts. While business leaders elsewhere excel at improving productivity, developing worker commitment, and producing high-quality products, U.S. leaders merely plod along, content to pursue short-term gains. Indeed, the Japanese are so renowned for their long-term perspective and use of quality-control circles, highly automated factories, and other advanced practices that the teaching of Japanese management techniques has recently blossomed into a major growth industry.

Is it any wonder, then, that American managers feel as though they are under attack? Or that claims of foreign superiority have sparked a backlash—a desire to root blindly for the home team?

Thomas J. Peters and Robert J. Waterman, Jr., have added new ammunition to this debate with their book *In Search of Excellence: Lessons from America's Best-Run Companies*. Their message, quite simply, is that "it can happen here." Drawing on extensive interviews at leading U.S. corporations—including Bechtel, Boeing, Delta Airlines, Digital Equipment, Hewlett-Packard, IBM, Johnson & Johnson, McDonald's, and Proctor & Gamble—the authors have developed a list of attributes that distinguish the most successful performers, gauged by measures such as long-term improvement in profitability, from those who have performed only adequately. Peters and Waterman also provide a loosely organized theory of management to bolster their empirical findings.

Excellent U.S. companies, they maintain, "display a bias for action." This go-for-it mentality is reflected in extensive experimentation and a willingness to accept failures; the widespread use of task forces and other ad hoc teams; and an emphasis on simplicity, including concise paperwork and lean corporate staffs. Most of these companies are also intensely customer-oriented, emphasizing quality, service, and reliability to a degree that other firms would consider uneconomical. These firms keep organizational units small and authority decentralized. Few of the companies are widely diversified; most stick to limited activities that they know well. All emphasize a few basic values (although these differ by company) leading to strong corporate cultures.

Perhaps most important, excellent companies are distinguished by their respect for their employees. These companies view themselves as extended families. Information is widely shared, both up and down the chain of command. Individual contributions are celebrated whenever possible, and people are made to feel good about themselves in hundreds of little ways.

Nonconformists Need Not Apply

Sound idyllic? It does indeed, and that points up a weakness of the book. In their relentless cheerleading, Peters and Waterman sometimes overlook less desirable aspects of the excellent companies. This is particularly true in the area of corporate culture, a major feature contributing to high performance.

A strong corporate culture undoubtedly produces a unified vision, cooperation among employees, and deep loyalty to the firm. Unfortunately, it also normally requires some element of coercion or discrimination to succeed. Incoming managers at these companies are carefully screened, as are employees. If they seem to fit, they are then subjected to extensive socialization. The enforced dress code (white shirts only) during IBM's early days is a relatively innocuous example, but others are more onerous, for independence of thought may be at stake as well.

For example, individuals must mold themselves to fit the character of these companies if they are to have any hope of advancement—wholehearted acceptance of the firm's basic philosophy is a must. Thus, a strong corporate culture can be confining as well as uplifting.

This criticism parallels that levied at Japanese companies, where individuals often must stifle their personal desires to further the group's objectives. Workers and managers are normally recruited from quite limited circles, and women and minorities are usually offered positions of lesser importance. American managers have seldom found such practices appealing, yet they are a more extreme example of those U.S. companies use to encourage homogeneity and thus maintain a strong corporate culture.

Parts Don't make the Whole

Despite these potentially undesirable side effects, many American firms will conclude that the excellent companies are ideal role models. The question then becomes: how can we become more like them? Here *In Search of Excellence* is most misleading, for the advice the authors offer to managers—adopt the practices of the excellent companies and you, too, shall succeed—is unlikely to produce the desired results.

The problem lies in the limited value of adopting only parts of the whole. Exceptional quality or service, a high degree of innovation, and constantly improving productivity are the combined result of countless little steps, not the product of a single dramatic change in organization. Peters and Waterman emphasize this interdependence when discussing the companies' respect for the individual: "Like so much else we have talked about, it's not any one thing—one assumption, belief,

statement, goal, value, system, or program—that makes the theme come to life. What makes it live at these companies is a plethora of structural devices, systems, styles, and values, all reinforcing one another."

And there's the catch. Excellent companies differ from run-of-the-mill performers not only in their policies and procedures but in their fundamental character as well. All have deeply rooted philosophies and modes of operation developed over an extended period of time. The fact that all the pieces fit together into a mutually reinforcing whole is the source of the companies' great success, not a few distinctive practices. This is also true of the most successful Japanese companies.

Even more telling, the culture of the excellent companies has almost invariably been set by a dominant leader, often someone involved with the firm in its early stages of development. This leader established the basic character of the company at the beginning, to be refined over the years. Bill Hewlett and David Packard, Thomas Watson of IBM, and Robert Johnson are largely responsible for the way their firms do business even today.

Thus, firms wishing to improve their performance are going to make only limited progress by mimicking individual procedures of the excellent companies—or, for that matter, by adopting the most celebrated Japanese management practices. As Peters and Waterman note, plenty of other companies have tried the same approaches and failed. The secret lies in infusing the company with a vision and then designing specific policies to meet those ends.

The prognosis for the average company, then, is not overly favorable. The little things that the excellent companies do so well—communicating with one-page memos, insisting on close customer contact, and institutionalizing entrepreneurship—are unlikely to be successful without the overlay of a strong supporting culture. And the path to developing the culture in the first place is not very well marked. Peters and Waterman have told us much about what constitutes excellence in American management. Unfortunately, they have failed to tell us the best way to get there. □

David A. Garvin is assistant professor of business administration at Harvard Business School.

Networking for Success

Winning the Games Scientists Play
by Carl J. Sindermann
Plenum Press, 1982, $15.95

Reviewed by Lynn Hall

The best thing about this book is its wonderfully provocative title: at last, I thought, an insider has blown the lid off the ivory tower. At best, I hoped that the book would delve into the scientific personality; at least, I expected a trendy, looking-out-for-number-one-type guide to getting ahead in science. But *Winning the Games Scientists Play* turns out to be neither.

Carl J. Sindermann, director of the Sandy Hook Marine Laboratory, explicitly rejects as too "negative" the standard definition of a psychological game as a set of transactions between people with ulterior motives, a concept popularized by books such as Eric Berne's *The Games People Play*. Although Sindermann's reluctance to psychoanalyze the scientific community might be understandable, his flat denial of subconscious motivations leaves him in the uncomfortable position of rationalizing behavior that isn't always rational. By choosing to look only at *how* scientists act and interact, not *why* they act the way they do, the author makes a serious error.

Instead, Sindermann's definition of game playing includes all the things scientists have to do other than science. His aim is to provide rules for correct behavior on what he calls "the great playing fields of science—cocktail parties, symposium mixers, [and] review committee meetings." Although these guidelines are generally quite reasonable, little of this information will be news to any but the most novice scientists. Sindermann glosses over or completely ignores more fundamental games of scientific life: establishing a "name," getting tenure and research funds, and becoming part of the "in crowd"—a crucial and difficult game for women and minorities.

Why do scientists act the way they do? Psychiatrist Lawrence S. Kubie hypothesized that scientists tend to become compulsive about their work because the training process leaves them no time or energy to become well-rounded and, more importantly, because their entire sense of self-worth is linked to the progress of their careers. Although this theory doesn't explain all the quirks of scientists' behavior, it does shed some light on the competitiveness found in science, fueled by the difficulties of obtaining jobs and research funds. This compulsion makes the ferocity with which scientists occasionally attack one another more comprehensible—a scientist's work is, to a greater extent than in most careers, his or her life.

Being One of the Boys

In the one chapter in which Sindermann does look at the scientific psyche, "Evaluating the Roles of Men and Women in Science," he manages to present only simplistic categories of scientists of both sexes. His categories for male scientists include the rigid asexual, the good old dad, the big daddy, the dirty old man, and the male prostitute. Although these types are extreme, Sindermann devotes most of his discussion to what he identifies as the three types of women scientists. Type I are "those who want their gender totally ignored in every aspect of their work—who want to be treated exactly and precisely as men . . . They want scientific competence and productivity to be the sole criterion for rewards." Type III includes "the 'scientific hustlers'—usually attractive, reasonably bright, and willing, who dabble in science but are really more interested in men. These are women who will use sex to achieve their goals."

Between the two extremes comes "the Type II woman in science, [who] is much more interesting and complex. She may be just as competent and productive as Type

ILLUSTRATIONS: LUCY DILLON RASTETTER

I, and she fully expects all the fruits of equal treatment in terms of rewards—but *additionally* she expects benefits to accrue from her femaleness. She knows that most men are romantics . . . She also knows that most men like to do things for women, especially attractive ones; and she does not hestitate to ask for favorable treatment.

"Type II women have the greatest potential for advancement in scientific management and administrative roles. Femaleness is of no advantage or disadvantage at the laboratory bench . . . but can be of great advantage in all other aspects of science—especially those that involve interpersonal relations in a field whose hierarchical structure and decision-making components are still largely male."

Just what does Sindermann mean? Are his Type II women canny manipulators of weak, incurably romantic males, or are they the unconscious beneficiaries of male scientists who just can't resist a pretty face? What "favorable treatment" do his Type II women scientists ask for—the best seat at the conference table? Flowers? Tenure? And does he seriously think that femininity is an advantage in what he admits is a male-dominated profession? On the contrary, many of the traditional "feminine" traits—passivity, gentleness, noncompetitiveness, and modesty—are handicaps when playing the "game" of succeeding in science. As much as any profession, the characteristics one needs beyond sheer intelligence are those traditionally considered "masculine": assertiveness, competitiveness, a thick skin, and a large ego.

More fundamentally, one has to doubt the validity of a classification scheme based solely on a woman's willingness to use her sexuality to manipulate men. Sindermann's "types" sound suspiciously like those antique stereotypes of career women: the man-haters, the prostitutes, and the "nice girls" who are bright *enough* but still act the way men expect them to. Needless to say, the pressures on women scientists, and their behavior in response, are vastly more complex than Sinderman admits.

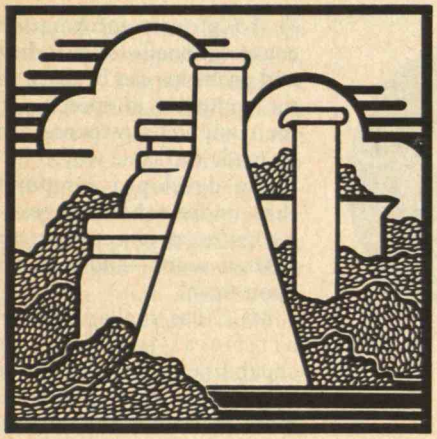
As a young woman scientist, the least of my problems is whether or how to manipulate my male colleagues. The real problem is playing the game "Being One of the Boys." As sociologist Jonothon R. Cole has noted in an article in *American Scientist*, "Being part of the proper social network, being linked to the 'right' people, plainly goes some distance in determining the paths taken in a scientific career and contributes to making science fun. None of this, of course, is a substitute for talent. But given talent, it plays a significant role in launching and sustaining careers."

As a woman, I find this "networking" game quite difficult. Many older men, and a few younger ones, are uncertain how to act around a woman who is a colleague rather than a secretary or wife. And some of the main activities that younger scientists use to form social networks—such as athletics in my department—are male-oriented or male-dominated.

The other "game" I've had to play, a variation on "Being One of the Boys," is called "Take Me Seriously." Since the image of the scientist is still masculine, the more feminine a woman is, the harder she has to work to be accepted. Thus, it helps to appropriate certain masculine traits of speech, dress, and behavior—a variation on the "dress-for-success" techniques used by women in business. Since scientists tend to be rather conservative socially, any inappropriate (nonserious) behavior, from both men and women, is frowned upon.

Sindermann does look briefly at larger issues that could easily have formed the seeds of a much longer book, such as career paths in science, getting and using power, and coping with bureaucrats, lawyers, and the media. But he writes that "some may feel after reading this book that the real world of science is simpler and purer than that portrayed here—that there is less opportunism, fewer calculated steps, and none of the manuevering." In fact, the "real world" of the scientist is much more subtle and complex than the one he describes. □

Lynn Hall, a doctoral candidate in geophysics at M.I.T., was a 1981 AAAS Mass Media Science Fellow at *Newsweek*.



Understanding Science by Doing It

Science and Technology Centers
by Victor J. Danilov
The M.I.T. Press, 1982

Reviewed by Joel Orlen

Science museums are among our most popular cultural institutions as measured by attendance figures. In contrast to the quiet decorum and "hands-off" approach of traditional natural-history or art musuems, science centers are modern, bright, and colorful. Their exhibits are lively and entertaining, encouraging hands-on involvement and requiring no special background or interest on the part of the average visitor.

Victor Danilov, president and director of the Chicago Museum of Science and Industry, has written a timely and comprehensive account of the science-center movement. He has accompanied this account with an instruction manual on how to build your own science museum, covering everything from inception of the idea to daily operation.

The movement to establish science and technology centers traces its origin in part to the international exhibitions celebrating technological progress beginning with the Crystal Palace Exhibition of 1851 in London. The interest generated by technological achievements during World War II and the space program sparked more recent growth. Today there are over 100 science centers in the United States, most built since 1960.

While serving a number of useful purposes, these centers pride themselves most on contributing to a better public understanding of science and technology and on supplementing school programs. However, measuring how well science museums fulfill these goals is difficult because the large number of visitors of varied backgrounds tends to sample exhibits rather than tour them systematically.

Danilov fails to mention an even more compelling public purpose served by science centers. Most people rate science and technology among the highest achievements of contemporary civilization, and science centers—local "crystal palaces"—make these achievements accessible for celebration by all. For millions of Americans, these centers provide the only exposure to scientific advances they hear about but can't experience firsthand. Exhibits on cosmology, subatomic particles, quantum effects, lasers, rockets, spacecraft, computers, and robots can induce a sense of personal involvement in science not otherwise available. For many of today's visitors, this vicarious participation engenders an all-too-rare sense of wonder—of horizons extended beyond daily concern.

But some observers have sharply criticized science centers for using a "huckster" approach more akin to the spirit of the international exhibitions. These critics accuse science museums of indiscriminately celebrating science and technology and failing to ask questions about possibly undesirable or dangerous side effects. Although Danilov dismisses these views as "grossly exaggerated," science centers face a genuine dilemma concerning technological topics of hot dispute.

Of course, exhibitors could claim that they simply present the "facts" and let visitors draw their own conclusions. But technical experts often dispute the facts and interpret risks differently, and science centers are no better than other institutions at being objective. Indeed, the idea that any exhibit on a controversial subject could be unbiased is simplistic—perhaps wholly unrealistic. The situation is further complicated by the fact that many science centers obtain much of their financial support from local industries with some vested interest in new technology. The Association of Science-Technology Centers has addressed this problem at national meetings but has not found a solution.

Danilov also fails to discuss what I consider the most troublesome aspect of the science-center movement—the difficulty of producing exhibits that do justice to the breadth and pace of modern science. A science exhibit of any scope requires specialized talents and substantial financing—several hundred thousand to a few million dollars. Most centers have annual operating budgets of $500,000 or less, almost all allocated to maintenance. Even the few centers with annual budgets of $3 million or more must reserve a large portion of their funds for fixed costs. Thus, although the staffs at science museums tend to be able and often outstanding, their work is limited. And each center produces its own material, often overlapping what others are doing. Although touring exhibits are common, they are usually low-cost projects that constitute a small—albeit important—part of science-center programs.

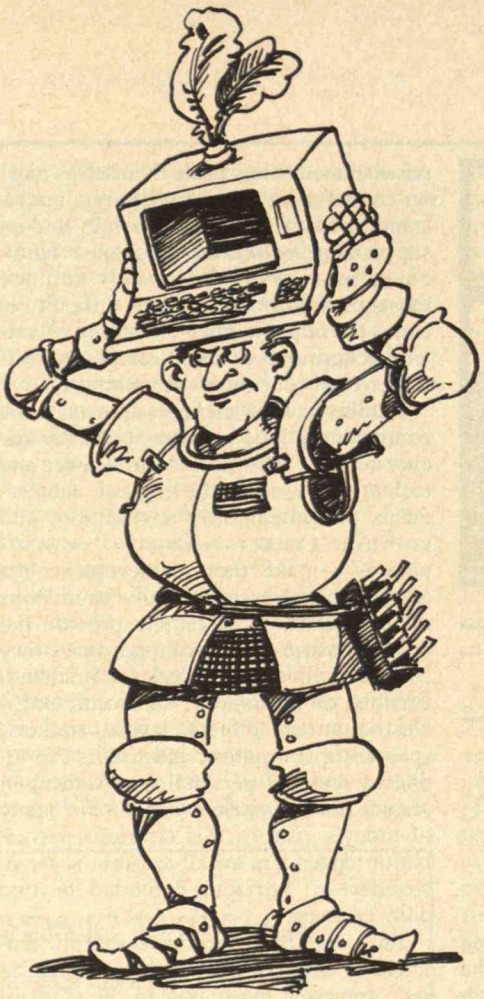
These offerings need to be augmented with high-impact exhibits large enough to treat adequately the themes of modern science and technology. The only practical way to do this is through major traveling exhibits comparable to the "blockbuster" touring art exhibits such as the "Treasures of Tutankhamen." These traveling science exhibits should be significant enough to gain national media attention and attract 5 to 10 million visitors as they tour a dozen or more cities.

Such spectacular exhibits could draw crowds willing to pay admission fees equal to those of a first-run movie—fees that could cover most expenses. Corporations and philanthropies could underwrite the initial costs, and participation by major scientific institutions such as the American Association for the Advancement of Science, the National Academy of Sciences, and the Smithsonian Institute could assure involvement of the nation's most qualified experts.

Today's science-center productions are sometimes criticized for emphasizing the spectacular at the expense of the concept, for aiming more at entertainment than instruction. But museum directors have learned that entertainment is essential if their programs are to have the wide appeal their mandate requires. The goal is to create a spectacle that also serves the more demanding purposes of education. □

Joel Orlen is vice-president of the Science Museum of Minnesota in St. Paul; he was formerly executive officer in the Office of the Provost at M.I.T.

A Face-Off on Computers



The battle lines are drawn and the stakes are high—no less than world leadership in the information revolution. A Japanese government-industry collaboration is well underway on a billion-dollar ten-year research and development effort to assure "computer supremacy." And a consortium of American companies has formed the Microelectronics and Computer Technology Corp. (MCC) to assemble a similar "superfunded" research and development effort in the United States.

The Japanese "fifth-generation computer project" begins with by far the most audacious goal: world leadership in the information field "through systems that strive to approach a human level of intelligence," in the words of Professor Michael L. Dertouzos, director of M.I.T.'s Laboratory for Computer Science.

Matching this adventurous scenario will be a tough assignment for MCC, which will try to skirt the hazard of U.S. antitrust proceedings by limiting its activities to basic research into areas of general applicability. Ten U.S. companies have so far committed a total of $30 million, and the first job of MCC's new president, Admiral Bobby R. Inman, former deputy director of the CIA, is to bring in more companies to achieve the funding goal of $100 million.

MCC versus Japan is not quite a standoff. Even if Japan's fifth-generation project fails to reach some of its ambitious goals, the technological superiority they imply represents a serious threat to the United States, writes Richard Dolan in the *Scientific Bulletin* of the Far East (Tokyo) Branch of the U.S. Office of Naval Research. He thinks the Japanese fifth-generation program has been both underpublicized and underestimated in the United States. Losses to the U.S. computer industry in the 1990s "could be greater and more precipitous" than those already experienced by industries such as automobiles and consumer electronics, he writes.

Briefly summarized, here are the goals of the fifth-generation computer project, as outlined by Dertouzos:

☐ To translate by machine from Japanese to English and back, and eventually also to accomplish Japanese-German and Japanese-French translation. According to Dolan, such a translation program is to have a vocabulary of 100,000 words and be 90 percent error-free—a tough goal, given the idiosyncracies of language. For example, "whether a certain Japanese word is translated as 'heat,' 'fever,' or 'passion' depends on whether the subject is thermodynamics, medicine, or love," says Dolan. "And if the machine is to make these choices it must pick up its clues from the meaning of the text, as humans might."

☐ To develop expert computer-based systems that users can turn to for information in fields such as medicine, much as they would consult a human specialist.

☐ To process information conversationally, so that data and problems can be given to the computer in speech and the computer's response can be made the same way.

☐ To develop a computer that understands images—recognizes an object, chart, or written word—and can act upon them.

MCC has similar goals in artificial-intelligence capabilities, though they're expressed with somewhat more restraint. The consortium will concentrate on seeking "major advances" in computer-aided design and manufacturing, an "order-of-magnitude improvement" in software, and better ways to interconnect computers and peripheral equipment.

Both MCC and the Japanese talk about devising silicon chips vastly more complex than today's—a single computer-designed chip carrying 10 million transistors, for example.

The logic of Japan's ambitious project is clear to both Dertouzos and Dolan. Lacking natural resources, the Japanese cannot count on long-term world leadership in heavy manufacturing industries such as automobiles. Because the Japanese population is large and the labor force highly trained, particularly in mathematics and technology, "the information revolution and Japan are an ideal match," Dertouzos says.

The Japanese also have other advantages in the information-technology race. The fifth-generation project was announced nearly two years ago. Thus, even if MCC were fully funded and at work today, the Japanese would have a substantial lead. The antitrust problem doesn't occur in Japan, either. And funding equivalent to $50 million has been

ILLUSTRATION: JON McINTOSH

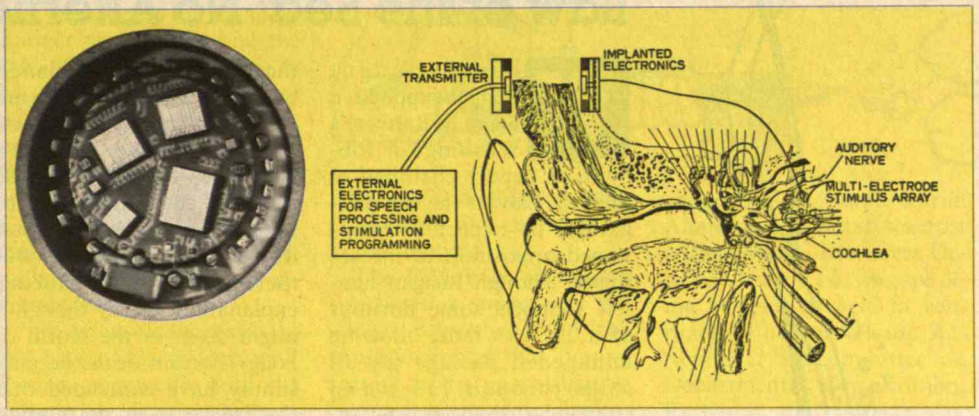
assured for the first three years. In contrast to MCC, industry supports only a small fraction of the Japanese program; most of the funds have been committed by MITI, the government's industrial development agency. However, project leaders may have chosen to express their goals in such spectacular terms because future funding is not so secure.

The United States has one advantage—a bittersweet one, says Dertouzos. The Japanese have adopted most of their microprocessor technology from the United States, he says: we've been ahead in that field. But U.S. companies have been unwilling or unable to make the long-term investments necessary to exploit these new ideas. Whether MCC is too little and too late, and whether the United States will wake up to another Sputnik by the end of this decade, remains to be decided.—*John Mattill* □

The Electronic Ear

Like reeds swaying to the wind, the tiny hair cells of the inner ear sway to sound waves, transforming mechanical vibrations into electrical signals for the brain. Damage to these delicate hair cells is what causes profound deafness in hundreds of thousands of Americans.

For some years, surgeons have been able to repair injuries to the eardrum and middle ear that cause other types of deafness. But now, engineers at Stanford University have developed a way to bypass damaged inner-ear cells and translate sound directly into electrical signals that stimulate the auditory nerves.



To treat deafness, engineers can trick the brain into thinking ear cells are working. Their artificial ear consists of a microphone behind the ear, a radio receiver in the ear (magnified here, the receiver is actually smaller than a quarter), and wires that carry impulses to electrodes. These emit electrical shocks, stimulating nerves to convey messages to the brain.

In Stanford's "artificial ear," a small microphone attached behind the patient's ear hears the sound and converts it to radio waves, which are sent to a receiver implanted in the ear. The receiver, which is smaller than a quarter and picks up eight channels, converts the radio signals into electrical impulses. Eight wires carry these impulses to platinum-coated microelectrodes inserted into the inner ear. There, the electrodes emit minute electrical signals that stimulate the auditory nerve fibers. These convey the signals to the brain.

"We are attempting to trick the brain into thinking the ear is working," says Robert White, chairman of the Department of Electrical Engineering at Stanford. "But we have a long way to go."

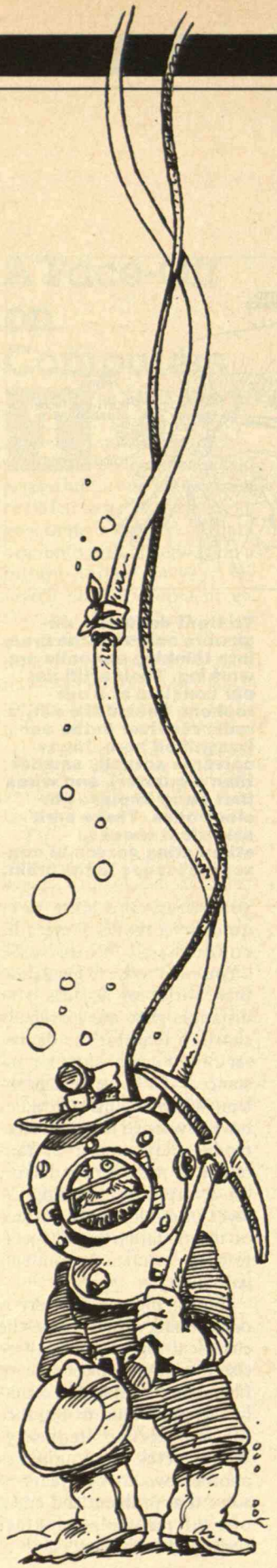
Two profoundly deaf patients using the Stanford implant have been able to distinguish, with 80 percent accuracy, the correct word among eight similarly sounding words. And researchers at the University of California have reported a startlingly high degree of speech recognition by two patients with a simpler implant in their ears. At this point, however, most of these simpler implants only allow a deaf person to sense when the telephone is ringing or someone is talking. Despite these limitations, two hundred of these simpler systems have been implanted in patients worldwide.

The ultimate goal is to develop an implant that allows its wearer to recognize the stream of words in normal conversation. The problem is that the ear is an incredibly sophisticated mechanism compared with a one-channel, or even an eight-channel, receiver. The snail-shaped, fluid-filled cochlea in the inner ear performs like a finely tuned instrument. The thousands of hair cells are arranged like piano strings in order of pitch, and the 30,000 to 40,000 auditory nerve fibers are also attuned to a range of high, medium, and low-pitched frequencies. Good speech recognition, White says, depends on the ear's sensitivity to the range of frequencies and tones of loudness.

One of the most difficult tasks in developing a sophisticated electronic ear is finding materials that can survive for years in the salty, fluid-filled environment of the inner ear. "Body fluids are very similar in composition to seawater and can very quickly corrode a metallic conductor," White says. "You need to have insulation that works for decades over distances that are extremely short—a tenth of the diameter of a human hair, for instance." To solve this problem, White and his colleagues have developed thin-film electrodes that consist of tantalum, a metallic conductor, on a sapphire backing. A layer of oxide on the surface of the tantalum seems to effectively insulate it from salt corrosion.

But the biggest difficulty is determining how to time the electrical signals more precisely so the auditory nerve fibers are stimulated at exactly the right time to produce the appropriate frequency. White gives the engineers another two to five years to solve that problem and crack one of nature's trickiest codes.—*Alison Bass* □

DIAGRAM: STANFORD UNIVERSITY



Law of the Sea: No Alternative

When President Reagan appointed Leigh S. Ratiner, a Washington lobbyist, as deputy chairman of the U.S. Law of the Sea delegation, he expected impassioned opposition to the sea treaty. Though Reagan himself supports some portions of it, such as those allowing unimpeded passage for all ships through 115 ocean straits, he opposes U.S. approval. The president is primarily against portions of the law creating a sea-mining consortium of mostly developing countries—to be financed from the sea-mining profits of developed countries and built on their technology.

Reagan's expectations of Ratiner seemed well founded. Kennecott, one of the commercial mining consortiums opposing the sea treaty, hired Ratiner to battle it during the Carter administration. And late in 1979, when the United Nations unanimously voted for a moon treaty with terms much like those of the sea treaty, U.S. space enthusiasts of the L-5 Society—some 3,500 people including astronauts, scientists from universities and industry, and politicians—hired Ratiner to block it. He and others gave so many nations second thoughts that the moon treaty never became law.

When you have a halfback like that, "you don't expect to have to tackle him," says a staffer for Rep. Jack Fields (R-Tex.), who was involved in the Law of the Sea negotiations. But now that the United Nations has voted for the sea treaty and it is up for ratification by individual countries, Ratiner has done an about-face. He is one of its leading boosters.

Washington rumor has it that Ratiner reversed himself because he found some wealthy protreaty clients. After all, Ratiner has been able to represent such diverse clients as the governments of Liberia both before and after its Marxist revolution. But there may well be a better explanation. Corny though it might seem in the world of Foggy Bottom deals, he may simply have concluded that the treaty is in the United States' best interest.

Writing in *Foreign Affairs*, Ratiner agrees that "the totality of the seabed mining provisions are hard to defend on the merits." Specifically, the treaty creates an authority to exploit seabed resources—including the fields of potato-sized manganese nodules that may be worth as much as $1 trillion—and distribute the proceeds to the world's disadvantaged nations. According to the treaty, the distribution should take into "particular consideration the interests and needs of the developing states and peoples who have not attained full independence or other self-governing status." The House Republican Research Committee thinks this provision would fund groups such as the Palestine Liberation Organization. The United States would be obligated to provide $500 million in interest-free loans to the mining authority, thereby setting up competition with U.S. mining ventures. And the authority would be empowered to force ocean-mining companies from developed countries to share their technology.

Doug Bandow, a former U.S. deputy representative to the Law of the Sea conference, says, "If only the United States, Japan, United Kingdom, West Germany, Belgium, Italy, and Spain stay out [of the sea treaty], the nonsigners will account for more than half the world's production. They will also include most of the likely seabed mining nations. Thus, even if the treaty is ratified by 60 nations and enters into force, it will be just a hollow propaganda shell."

But Ratiner fears that these industrialized powers, even without the United States, are likely to join the Soviet block and the Third World to ratify the sea treaty. They would then create "an historic global organization—one that for the first time regulates, manages, and produces globally shared resources. One day this institution could use its taxing power to become self-financing.

"Should this all occur without American influence, participation, and leadership," Ratiner writes in *Foreign Affairs*, "our nation will suffer a much more serious adverse precedent than any of the adverse precedents we fought against in the treaty negotiation itself. We will stand as the emperor without clothes—for the entire world to see what it can do without American money, leadership, or technology."

Members of the House Committee on Merchant Marine and Fisheries grilled Ratiner on his position last July, taunting him with quotes from his congressional testimony against the moon treaty. "What is your alternative to the Law of the Sea?" Ratiner retorted.

Ted Kronmiller, deputy assistant secretary of state, asserted to committee members that there is in fact an alternative: the 1980 Deep Seabed Hard Mineral Re-

ILLUSTRATIONS: JON McINTOSH

sources Act, an offspring of a 1976 Ratiner initiative to provide a fallback position against the sea treaty. This bill authorizes the United States to create an alternative minitreaty among nations with deep-sea mining interests.

But Elliot L. Richardson, Carter's ambassador to the sea-treaty conference who was fired by Reagan in 1981, allegedly at Ratiner's request, came to his erstwhile opponent's aid. He insisted before the House committee that "no rational investor will gamble $1.5 billion on a deep-seabed mining project" with only the 1980 Deep Seabed Act in force. He was concerned that if the United States refused to ratify the Law of the Sea treaty, other nations, including allies, would retaliate by refusing to cooperate in the minitreaty.

Since then the United Kingdom, Germany, and France have joined the United States in signing the minitreaty, and three mining consortia are committed to operating under it, Kronmiller said. Conrad G. Welling, senior vice-president of the multinational Ocean Minerals Co., doesn't think anyone will finance ventures under the terms of the sea treaty: "If you have several courses open and some say 'maybe' while one says 'no,' you go with the maybe."

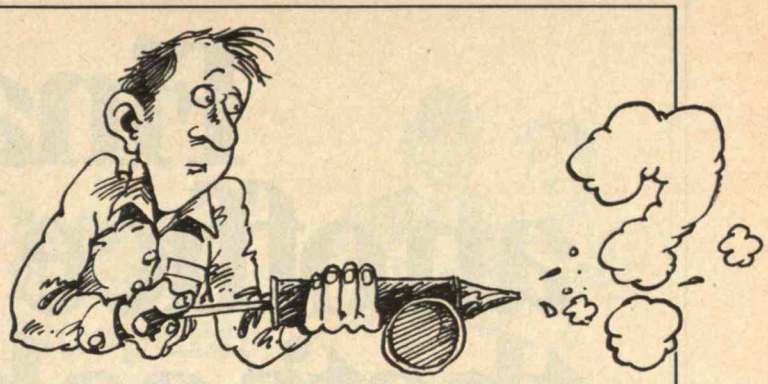
Richardson and Ratiner are skeptical. The sea treaty does not prevent minitreaties—indeed it directs countries to create minitreaties fleshing out its own provisions. But Richardson fears that no minitreaty will remain valid if one of its signators—such as the United States—fails to join the more comprehensive sea treaty.

When deep-sea mining companies go to the bank, they may be in for a shock, Ratiner predicts. He says the U.S. minitreaty will prove to be a "worthless piece of paper that no commercial, publicly owned bank could use as a basis for extending credit." He expects the International Court of Justice to rule the minitreaty invalid, pulling the plug out on investments.

"Show me an alternative to the Law of the Sea treaty," Ratiner repeatedly told the committee. So far, he sees none.—*Carolyn Meinel* □

As president of the L-5 Society for Space Development, Carolyn Meinel coordinated the effort that defeated the 1979 U.N. Agreement Governing the Acts on the Moon and Other Celestial Bodies–a treaty incorporating verbatim many sections from the Law of the Sea treaty.

Menacing Pesticides



Evaluating whether pesticides should be used on crops—based on whether they are carcinogenic—is a thorny business. Tests on animals must be extrapolated to humans, sequences of cause and effect may be uncertain, and the final decision inevitably involves someone's best judgment. When politics are added to this mixture—as some critics charge is happening now—matters become even more tangled.

Roy Albert, chairman of the Carcinogen Assessment Group of the U.S. Environmental Protection Agency, says that the basic criteria for assessing pesticides did not change under Reagan's former EPA administrator, Anne Burford. But a number of scientists and environmentalists disagree.

The EPA may even have concocted a supposedly scientific hypothesis for the causes of cancer that "has no factual basis," according to Bernard Weinstein, director of the division of Environmental Sciences at Columbia University's School of Public Health. Specifically, critics say the EPA has been distinguishing between "genotoxic" compounds, which can cause cancer by mutating the genes of cells, and "epigenetic" compounds, which supposedly promote cancer without affecting genes. A single molecule of a genotoxin can cause mutations, the theory goes, but repeated exposures to epigenetic toxins are required to produce tumors. The implication is that considerably larger amounts of epigenetic compounds are safe.

This notion is bogus, according to John Cairns, a professor of microbiology at the Harvard School of Public Health. Indeed John Todhunter, the former EPA assistant administrator for pesticides and toxic substances, largely agrees. In a letter to *Science* last February, he said that "it is premature to make hard and fast distinctions between 'genotoxic' and 'nongenotoxic' carcinogens as a general practice."

But has the EPA been doing so? "Although this proposal [to be more lenient on supposedly epigenetic pesticides] has not been formally adopted, the EPA appears to be acting on [it] as a de facto cancer policy," said Karim Ahmed, a senior staff scientist at the Natural Resources Defense Council. He was speaking at hearings held in February before the House Agricultural Subcommittee on Departmental Organization, Research, and Foreign Agriculture.

For example, the EPA authorized the use of the pesticide Permethrin on food crops, stating that its inability to mutate genes "indicates that Permethrin falls into the epigenetic category." However, Edwin Johnson, director of the EPA's Office of Pesticide Programs, says that this was a minor factor in the decision to allow farmers to use Permethrin on food crops.

The EPA's pesticide office also okayed the carcinogenic pesticide EBDC on the belief that it is epigenetic, EPA staff scientist Adrian Gross says. And a February 1982 memo from Todhunter based the safety of current regulations of formaldehyde (an industrial chemical, not a pesticide) on the likelihood that it is a "promoter"—or epigenetic, according to Ellen Silbergeld, a scientist at the Environmental Defense Fund.

Critics charge that the EPA has also weakened other aspects of pesticide regulations. A report by the full House Agriculture Committee published last December said that in certifying pesticides, the Reagan EPA has been allowing a cancer risk "10 to 100 times higher" than previous administrations.

Todhunter insisted at the subcommittee hearings in

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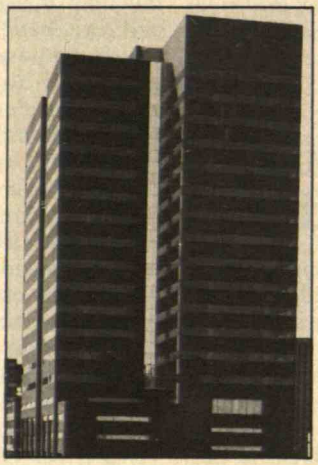

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February that "there has been no radical change in [the EPA's] policy" on carcinogens under the present administration. As for the hundredfold increase in risk factors, he cautioned that risk-assessment methods provide rough indices that can be used to compare one carcinogen with another but should not be taken literally. To make an issue of whether a risk is one-ten-millionth, one-millionth, or one-hundred-thousandth, he wrote in a letter to *Science*, is "equivalent to asking how many angels can dance on the head of a pin."

Environmentalists also charge that the EPA has increasingly allowed manufacturers to bypass accepted procedures and thus gain approval for questionable pesticides. "Emergency exemptions" from the normal procedures for clearing pesticides increased from 165 in 1978 to 727 in 1982, and "specific local-need registrations" (okaying pesticides for restricted geographical areas) increased from 440 in 1976 to 1656 in 1982, according to the Agriculture Committee report.

The EPA has encouraged companies that wish to register pesticides to consider such alternative routes, said Maureen Hinkle, agricultural policy coordinator at the National Audubon Society. For example, Mississippi pressed the EPA for a quick approval of Ferriamicide, which the state itself manufactures to counter widespread damage caused by fire ants. Ferriamicide contains the carcinogen mirex, which the EPA banned during the Carter administration, and Hinkle says there are 14 approved alternatives to it, though all have their problems. When Mississippi pressed the Reagan EPA for appoval of Ferriamicide, officials suggested that an emergency exemption "might be granted faster," according to Hinkle.

"Mississippi was in a difficult position," Edwin Johnson of the EPA pesticide office explains. "They came and asked us which of these procedures would work quickest to solve their problems. We couldn't say to them, 'We're not going to tell you which procedure will solve your problem.' "

Last July the EPA abruptly announced at a public hearing that in a "regulatory streamlining" measure, it would negotiate with companies as to which tests would be required to register pesticides, according to Hinkle. She charged that since such negotiations are not public, the process becomes "an underground art." However, Johnson says that the EPA openly states the basis for certifying chemicals: "We always make available the list of studies for reaching any registration or emergency exemption."

But perhaps not without nudging. The Natural Resources Defense Council has had to resort to Freedom of Information requests and go to court to obtain the health and safety data supporting the certifications of 11 major pesticides. The outcome of this controversy under Burford's EPA remains unclear. After sharp criticism, a document on cancer policy by the White House Office of Science and Technology Policy—with a chapter on assessing carcinogenic risks by Todhunter—is being revised. The final draft, due in June, will be taken into account by the new EPA.

David Holzman □

Business Plans: Blueprints for Success

For a budding high-technology enterprise, a business plan is "a critical first representation of who you are and what you want to be," says Edward B. Roberts, Sarnoff Professor in M.I.T.'s Sloan School of Management. Roberts gave participants in an M.I.T. seminar last fall a seemingly self-evident piece of advice: a well-prepared business plan "can make the difference between initial success and failure."

But Bernard M. Gordon, founder, chairman, and chief executive officer of Analogic Corp., announced that every rule has its exception. His company got off the ground without a business plan 13 years ago and grew to sales of $106 million last year.

Gordon was lucky enough to be able to finance his nascent company by himself. Thus, he didn't need a plan to convince outside investors of the soundness of his scheme. But that's not why he didn't write one—"I didn't know how," Gordon confessed.

He thinks most engineer-entrepreneurs today have the same problem. Trained as specialists, they're not really capable of plotting the future of a business in a way that would satisfy a cautious prospective investor.

Having studied the business plans of 20 would-be high-technology entrepreneurs, Roberts confirms that assessment. The majority, he said, lacked specific strategies for reaching the company's goals. Many of the plans said little about the level of profitability desired—financiers' primary interest—and nothing about the competition.

Roberts also observed that five of the plans focused on people—"a bad sign." That's "asking the venture capitalist to invest in a superstar who may not have done his homework." And most plans did not even mention marketing or sales. Too many entrepreneurs who want to make high-technology products don't seem to want to worry about selling or marketing them, Roberts said.

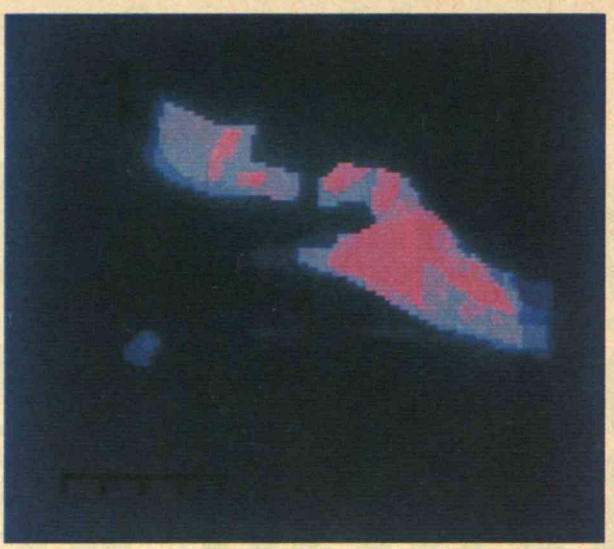
In general, most plans included well-developed research and development proposals and a clear statement of objectives. But manufacturing plans were less adequate. While most plans emphasized the technical edge the company would have, only half suggested any concern for protecting that edge. And most plans showed projections of income but few showed costs. Roberts believes such deficiencies explain why only 2 of the 20 proposed companies were funded by private investors.

Gordon supplied a final warning: once you've written your business plan, don't take it too seriously. "If you trace the history of companies that get past the level of a few million dollars in sales, you'll find that their course was not planned in advance."

Their success, he says, is the result of capitalizing on some unpredicted and unpredictable opportunity. Recognizing that crucial chance when it comes is vital to success.—*John Mattill* □

ILLUSTRATION: JON McINTOSH

Automatic Experts For Sale



Prospector, an "expert system" that mimics the thinking of human geologists, produced this map to pinpoint molybdenum deposits (shown in pink) in Washington. The prediction proved correct.

Oil companies decide where to drill by dropping a tool called a "dipmeter" down a hole and measuring various aspects of local geology. But dipmeter specialists to interpret these measurements are in short supply. So artificial-intelligence researchers at Schlumberger Ltd. of New York are developing an "expert system" to help them analyze geological data and advise oil companies where to drill.

Expert systems—computer programs that simulate the thinking of human experts—are beginning to be used in the real world, applying judgment to uncertain information to make recommendations. Reed Smith, program leader at Schlumberger, says that expert systems can make human experts' knowledge available to many relatively inexperienced technicians. They, in turn, can become more knowledgeable because the advanced systems provide explanations of the reasoning behind their judgments. And as geologists acquire more experience, they can add the new information to the "knowledge base"—a key factor that distinguishes expert systems from their more mundane software cousins.

Teknowledge, Inc., of Palo Alto has created another expert system for the petroleum industry to analyze what to do when a bit gets stuck while drilling. Drilling supervisors in the field will soon be able to use Dipmeter Advisor, developed for Elf-Aquitane, the French national oil company, as if they were working beside a human expert. Today oil companies must fly a highly paid cadre of experts all over the globe to handle drilling problems as they occur. But at Elf, the expert software will handle the routine cases, so human experts will have more time to troubleshoot difficult situations and investigate new techniques.

To create such a system, programmers, called "knowledge engineers," must incorporate not only experts' store of information but also the reasoning on which they base their decisions. Developing Dipmeter Advisor, for example, took six months of conferring with oil-drilling specialists and another six months of development.

To test Dipmeter, programmers fed it details of previous accidents culled from drilling logs and compared its recommendations with those of human experts. According to Teknowledge vice-president Jerry Kaplan, the system performs as well as human experts but addresses a more limited range of problems. Far from being threatened by this advance, human experts have told Kaplan they wouldn't consider *not* using such a system, as it is "as good all the time as they are on their best days."

Teknowledge advises clients to expect to invest $1 million in an expert system—a sum not every company can afford. However, Kaplan estimates that payback can be as short as a few weeks: operating a drilling rig, for example, costs $100,000 a day. With this potential for return, why don't other oil companies want their own system? "Too conservative," says Kaplan—and these are not the best of times for the industry. Still, he predicts that in ten years many expert systems will be in use in oil fields.

Teknowledge programmers also think that the time needed to create such a system can be reduced to a few weeks because one "inference engine"—or model of the way experts make decisions in one field—can be applied to other fields. Like a number of other companies in the artificial-intelligence business, Teknowledge is developing expert systems for companies in other fields but cannot divulge how they will use the software.

Cognitive Systems, a New Haven firm started by Roger Schank, chairman of the Computer Science Department at Yale University, is taking a different approach. The company's goal is to develop off-the-shelf rather than custom-made expert systems. These will help insurance agents choose which coverage best suits their clients and will help professionals do financial planning, including taxes, investment strategies, and simple wills. According to vice-president Anatole Gershman, people will be able to type in their commands in everyday English, so eventually anyone with access to the personal computer of the future could use the company's expert systems. However, in the short term the software is expected to cost $20,000 to $30,000 and require the memory capacity of a $40,000 to $50,000 computer, so insurance companies, banks, and brokerage houses are the most likely buyers.

Expert systems are also being used to help doctors diagnose disease and chemists design new compounds such as pesticides. The U.S. Geological Survey has just obtained an expert system from SRI International to help evaluate the potential of geological sites for various minerals. And Digital Equipment Corp. has designed a system to help configure its computers and decide what's wrong when one breaks down.

But expert systems face obstacles to widespread use. Not many programmers know how to create them: there are fewer than 200 knowledge engineers in the United States. Furthermore, most have left universities to work for private companies, so they are not around to pass their knowledge on to graduate students—and to advance the state of the art. Thus, the shortage is likely to continue—unless, of course, programmers design expert systems that take over some of their own job.—*Sandra Hackman* □

Continued from p. 8

university also noted in its written statement that "when research is published under multiple authorship . . . it must be self-evident that any fraud or inauthenticity in the work will taint all the authors. By claiming authorship of a scholarly publication, each collaborator must accept the discredit, as well as the credit, for the collaborative effort."

Last February, Stanford University also announced formal processes for investigating charges of fraud. As at Yale, this system is based on due process, with deadlines to help ensure that cases brought to university attention are adequately dealt with.

All universities and research institutions should quickly follow suit, yet establishing formal procedures will correct only part of the problem. The pressure-cooker atmosphere of many research labs and the publish-or-perish career ladder will still push individuals to cut corners. This system too needs rethinking. Also, honesty comes down to individual morality. Cheating on exams to get into medical school, which reportedly is common, can easily lead to fudging of research results. Sending duplicate papers to more than one journal in hopes of at least one acceptance is a minor infraction but can be the first step leading the perpetrator on to more significant fraud.

Perhaps it is time that the formal training of scientists included education in the ethics of research. This means that working scientists, especially those at universities, need to think through the ethics of their work. A tough-minded assessment of what the scientific community and society at large should expect of those entrusted with the pursuit of knowledge could help restore nobility to the enterprise. □

UPCOMING IN OUR JULY ISSUE:

Office Automation versus Bureaucracy
Some workers are gaining responsibility and some departments are becoming entrepreneurial, but computers don't assure that this will happen.

Beauty of a Bygone Age
Today's skyscrapers carry the legacy of the Crystal Palace, whose construction techniques were a century ahead of their time.

By the Sea: Wave Power
Enough energy to power the world is brought daily to our shorelines, but no technology can yet harvest it.

By the Sea: Tidal Power
Early New Englanders harnessed the faithful tides to power mills and factories. New research suggests a resurgence with the advantage going to those who think small.

Japan Inc.: Fact or Fiction?
The conventional view of Japan's commerce—an economy whose growth is mandated by government—is a myth.

Four Threats to Free Knowledge

Especially in the new world of knowledge-intensive high technology, knowledge is power: those who have it have power over those who do not. Thus, the distribution of knowledge in society is an issue of "transcendent importance," says President Paul E. Gray in his annual report for 1982 to the M.I.T. Corporation.

Much of Dr. Gray's report is devoted to discussing four recent examples of conflict in the distribution of scientific knowledge:

☐ As industrial sponsorship of academic research increases, the inherent tension grows between the legitimate proprietary concerns of an industrial sponsor and the traditional—and invaluable—freedoms of the academic community. Dr. Gray's conclusion: industrial research sponsorship can represent an asset in every respect—to the sponsor, to the university, and to the society that benefits from new knowledge however derived. He believes that effective safeguards of corporate and university interests can be fashioned between sponsors and researchers.

☐ Private research relationships—epitomized in M.I.T.'s case by the Whitehead Institute for Biomedical Research—present similar threats to the wide availability of knowledge and the university's prerogative to determine its future course. President Gray admits the risk but declares that the new opportunities override it: "We will all gain from the significant expansion in the community of scholars in this field," he writes.

☐ Convinced that the Soviets have become "very effective in sifting the U.S. scientific and technical endeavor" for information useful to their military advantage, the Reagan administration has sought to extend export controls "beyond materials and devices to include the international traffic in ideas," President Gray noted. But he protests: "This country's scientific and technological leadership has its roots in the universities, whose strengths are based on open and shared exploration of ideas in education and research. A departure from this principle . . . would mean . . . a loss of trained young people in just those fields the government is trying to safeguard."

☐ The government has reversed its policies of financial aid for students, proposing "very large reductions" in major programs. To the extent that government assistance assures access to knowledge for many Americans, these cuts are threatening—especially in a time when educational costs are rising steeply.

"The keys of knowledge must be accessible to all of us," writes Dr. Gray. "The struggle to make equal opportunity an American reality—not just an American dream—is even more important in these times, for the Institute as well as for the society of which we are a part." ☐

M.I.T. seniors are finding the recession a dicey time to hunt for jobs. Here crowds await the 9 a.m. opening of the Placement Office. Job offers are down even for electrical engineers and computer scientists, and the bottom has fallen out for chemical engineers. It's a good chance for companies that don't normally try to attract M.I.T. students to make the move.

Licensing for Profit

Marketing people began to gather around the water coolers and coffee machines of research and development departments during the 1970s—with the result that R & D produced far more commercially oriented results.

Now it's time for the patents and licensing people to do the same thing, says Professor Edward B. Roberts of M.I.T.'s Sloan School of Management. He thinks the result could be a "dramatic" increase in the exploitation and profitability of most firms' inventions.

Most new ideas from industrial research and development groups are used internally to improve products or processes or externally as a basis for spin-offs and joint ventures. Though most are patented, few—especially in the electronics and mechanical fields—are licensed, and even fewer of the licenses generate much income. A lost opportunity, writes Professor Roberts in *Research Management* (September 1982).

Thirty-three companies with major R & D activities surveyed by Professor Roberts told him that the great majority of their licensed patents yield annual income of less than $10,000; 20 percent yield less than $1,000. From the point of view of the originating large corporations, such numbers must be "wholly inconsequential," he says. Indeed, "only in highly infrequent occasions," Professor Roberts reports, "does any particular patent generate any significiant income."

In most such companies, the patent attorney is part of the legal staff—isolated from the commercial orientation of marketing and the technical orientation of R & D. For a better result, advises Professor Roberts, let the patent and licensing people think about the technical organization as a resource: plan at least part of the R & D effort on the basis of its profit potential through patents and licensing.—*J.M.* ☐

When Dieting Ends

For the successful dieter who suddenly gains back all that hard-lost weight, a word of comfort (and warning) from three members of the M.I.T. Laboratory of Neuroendocrine Regulation: carbohydrate deprivation—a common weight-loss strategy—alters the brain mechanism that normally regulates carbohydrate intake.

The result, say Judith H. Wurtman, Peter L. Moses, and Richard J. Wurtman, is a "carbohydrate binge" when dietary restrictions are removed. They urge dieters to control but not eliminate carbohydrate intake. But even then, the scientists say, "rebound eating" may be a problem. At least, says Ms. Wurtman, their research should "remove the guilt from an ex-dieter who thinks a craving for cookies is simply emotional." ☐

Managing as Loving

When we ponder how to increase the productivity of American industry, we think too much about capital investment and not enough about management, says J. Herbert Hollomon, Japan Steel Industry Professor of Engineering at M.I.T.

PHOTO: CALVIN CAMPBELL

"A good manager has three primary functions," writes Dr. Hollomon in AT&T's *Business Service Quarterly* : "To encourage people to work in a way that allows them to make a substantial personal contribution, to recognize success, and to give new encouragement after failure."

The manager's basic job is to "make it possible for others in the organization to function and to assure them of continuity in their work." In that sense, "managing is loving," writes Dr. Hollomon—"the caring of one person for the people he serves. . . . I believe the essence of the Japanese economic miracle is trust—the trust that exists between the worker and the manager." □

A Ten-Year Window of New Opportunities

If the recession that now grips the U.S. seems unusually tenacious, there's a reason, says Alan K. Graham, research director of the System Dynamics National Model Project in the Sloan School of Management.

The trouble is that we are in the trough of a business cycle and also at the bottom of a Kondratieff "long wave"—a 50-year cycle of overexpansion and technological change. The capital plant based on old technology is no longer fully utilized, but new technology is not yet ready to create jobs and profits—and may not be for another decade.

But the cloud has a silver lining: the era of technological innovation that marks the start of a new Kondratieff cycle is beginning, and it's a moment of great opportunity for investors and managers who choose the technologies of the future and invest in them now. Dr. Graham's advice: combine a conservative financial strategy (low debts) with a bold investment strategy, backing new ideas that seem to have the best chance for success when recovery begins.

"The corporate strategies adopted during the transition usually determine who survives to reap the benefits of the next 'long wave'," Dr. Graham writes in the *Journal of Business Forecasting*. Large debts are a special hazard during the long-wave transition, Dr. Graham writes, because "low profits squeeze cash flow and higher risks make banks less willing to lend." □

of the dodecahedron
□ the original icosahedron (of course)
□ one great dodecahedron, a kind of star imploding from the above icosahedron
□ golden rectangles extending between opposite edges of the icosahedron
□ and a good deal more.

"That's predestination," Bradley usually says after running over a list such as this. "It's beautiful."

Actually, he isn't sure what sculptures will come from these particular discoveries. "At some point the order becomes so dense that you can't follow it visually. Then I have to make a selection, and that is where aesthetic judgment comes in."

When Bradley decides what to do with his dodecahedra and icosahedra with squares added, he will talk and wave his arms and somehow his team of workers will understand. For example, when he decided on his "Sixty Helices"—spirals coiling in from the points of an imaginary dodecahedron—Linda Priest, adept at visualizing Greek geometrical terms, understood. She decided to make the helices out of Lexan, a plastic. Harald Robinson made a cone to coil them on, and she heated the rods, coiled them, and held them until they were cold. She fitted them into a centerpiece with 60 holes built by Robinson according to Rosenblum's specifications. "It was like working with a can of worms," says Priest. Finally, she applied the brilliant colors.

Bradley uses a color scheme devised by Albert Munsell, a nineteenth-century American artist who painted canvases such as "The Ascension of Elijah" and was obsessed with describing color scientifically. One should no longer speak of old-brick red but rather of R5/2. Bradley developed a color globe from Munsell's scheme. The hues—red, orange, yellow, green, blue, purple—circle the equator. Toward the north they lighten to white; toward the south they darken to black.

Bradley used the globe to create three sets of colors. If you fit a dodecahedron around the globe, the 12 colors touched by its faces form one set. The 20 colors that touch the faces of an icosahedron form another set. If you snap together a stick-form dodecahedron and a stick-form icosahedron, they intersect at 30 points. If you fit this structure around a color globe, the places where these points touch give a set of 30 colors. Separately or combined, all the color sets—of 12, 20, and 30—progress evenly around the rainbow of hues and shade uniformly from light to dark.

A sculpture can be colored in various ways. Take a great stellated dodecahedron—a star with 20 points. You could make each star-point one color using the 20-color set. "That would look awfully stubby," says Bradley. Each side of a star-point directly faces the side of another star-point. You could paint facing sides the same color, and that would require precisely 30.

It also happens that if you take the side of any star-point, you can find four other sides of four other star-points lying in the same plane, and the five sides together form a flat five-pointed star. There are 12 of these flat stars in all, so you could paint them using the set of 12 colors. As the great stellated dodecahedron turns, you see mainly the star-plane facing you, but it is almost camouflaged by nearby colors on other star-planes. This scheme makes a simple but compelling pattern.

Bradley often colors his sculptures in more subtle yet still orderly ways: describing the pattern may require a full written page in the record book that Rosenblum keeps on all finished pieces. "The synthesis of color space and geometrical space is the single most important idea in my sculpture," says Bradley.

The Sculptor as Discoverer

Many artists have based their work on quasi-mystical orders: one thinks of Leonardo's drawing of a man with his arms and feet spread-eagled, standing in a perfect circle, his anatomy laid out in neat proportions. "Perhaps I am pulling out the proportions that other artists put into things," says Bradley. "They varied the relationships—they had some freedom. I have freedom to carry out the operation, but I am stuck with the results."

As well as being a sculptor, Bradley is a well-known restorer of paintings, many of which could hardly be further from the spirit of his own work. For example, a primitive picture of a baby wise beyond its years stares out from a canvas, a leaf clenched in one hand, a black ring in the other. "Either you like primitives or you don't," Bradley says. "You can't learn to." He clearly cherishes them. This one was done by an artist named Prior. "He charged $2.50 without shadows, $3.50 with."

"Some people think I must have a badly divided personality to do my sort of sculpture yet work on nineteenth-century painters," he continues. "But they are both manifestations of order, and I see no reason why art shouldn't be intellectual." Then he muses that he didn't exactly create his sculptures. "In a sense they were waiting around to be discovered by someone. They are impersonal. That means it's okay to think they are beautiful—even for me."

JONATHAN SCHLEFER is a senior editor of *Technology Review*.

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